THE PROCEEDINGS

OF THE

SECOND

ALL-INDIA

SANITARY CONFERENCE

HELD AT

MADRAS

November 11th to 16th, 1912

VOLUME I—GENERAL

PROCEEDINGS AND RESOLUTIONS

SIMLA
GOVERNMENT CENTRAL BRANCH PRESS,
1913.

Price-Rs. 2-0-0.

462DB

INDIA SANITARY CONFERENCE AT MADRAS.

FIRST ROW.—Mr. T. Miller Brownlie. Capt. Morison. Major C. E. Williams, I.M.S. Mr. Motilal Ghosh. Major W. G. Liston, I.M.S. Major W. F. Harvey, I.M.S. Major F. H. G. Hutchinson, I.M.S. Major J. D. Graham, I.M.S. Dr. Amritaraj. Mr. A. W. E. Standley. Lt.-Col. C. Donovan, I.M.S. Mr. J. W. Madeley. Dr. C. A. Bentley. Capt. F. W. Cragg, I.M.S. Dr. J. B. Stephens. Capt. W. S. Patton, I.M.S. The Hon'ble Khan Bahadur Syed Mahdi Shah. Mr. J. M. Lacey. Lt.-Col. E. Wilkinson, I.M.S. Dr. Valentine. Capt. W. C. Ross, I.M.S.

SECOND ROW.—Khan Bahadur M. M. Mullah. Mr. V. D. Pillai. Rai Bahadur Kailash Chandar Bose, C.I.E. Mr. E. G. Turner, I.C.S. Major E. D. W. Greig, I.M.S. Major S. A. Harriss, I.M.S. Major H. A. Forbes Knapton, I.M.S. Dr. T. M. Nair. Dr. A. G. Newell. Capt. T. C. McCombie Young, I.M.S. Capt. F. P. Mackie, I.M.S. Dr. V. T. Korke. Mr. C. N. Mandy. Major W. W. Clemesha, I.M.S. Dr. F. Maitland Gibson. Mr. N. Belvadi.

THIRD ROW.—Mr. A. S. Montgomery. Capt. C. L. Dunn, I.M.S. Kunwar Maharaj Singh. Mr. D. B. Master. Mr. A. J. G. Maflin. Mr. G. W. Disney. Mr. B. B. Brahmachari. Mr. V. R. Iyengar. Mr. W. Hutton. Dr. W. Marshall Philip. Capt. O. A. R. Berkeley Hill, I.M.S. Capt. Norman White. Major T. G. N. Stokes, I.M.S. Mr. E. Gabbett. Major L. W. S. Oldham, R.E. Mr. C. L. Cox. Major N. P. O'Gorman Lalor, I.M.S. Dr. J. A. Turner.

FOURTH ROW.—(Sitting) Dr. W. R. Macdonald. Dr. P. S. Chandra Sekhar. The Hon'ble Rai Bahadur Ganga Prasad Varma. Lt.-Col. S. Browning Smith. Major J. C. Robertson, I.M.S. The Hon'ble Mr. L. C. Porter, C.I.E., I.C.S. The Hon'ble Sir Spencer Harcourt Butler, K.C.S.I., C.I.E., I.C.S. H. E. Lord Pentland, Governor of Madras. The Hon'ble Surgeon-General Sir C. P. Lukis, K.C.S.I. The Hon'ble Surgeon-General W. B. Bannerman, C.S.I. A. D. C. to H. E. the Governor of Madras. Rai Saheb D. Barua. Capt. W. A. Justice, I.M.S. Dr. J. G. Rutherford. Capt. A. G. McKendrick, I.M.S. Mr. C. H. West.

TABLE OF CONTENTS.

	Page.
The agenda ...	1
List of delegates ...	5
The President's opening speech ...	6

TOWN-PLANNING, CONGESTED AREAS AND BUILDING BYE-LAWS.

Town-planning ...	9
Light and air in dwellings in Bombay ...	11
Town improvement in Lucknow ...	13
Building bye-laws ...	13
Town improvement and drainage in India ...	13
Relief of congestion ...	14
Workmen's dwellings ...	15
Rules for laying out sites and planning model houses for the poorer classes ...	15
Inspection of the Madras city drainage works ...	16

TRAVELLING DISPENSARIES.

Travelling dispensaries in the United Provinces ...	17
Anti-malarial measures—Itinerating dispensaries ...	18

PLAGUE.

The annual reappearance of plague ...	20
The importance of the persistence of infection in certain villages during the off-plague season ...	21
Defective registration of plague deaths ...	21
A simple method of rat destruction ...	22
The grain trade as a factor in the dissemination of plague ...	22
Plague in the Madras presidency ...	23
A note on the fleas infesting the Mus Rattus in Naini Tal and Mussoorie ...	24
Plague preventive measures ...	24
Summary of discussion on papers relating to plague ...	25

SANITARY ENGINEERING.

The Simla hydro-electric scheme ...	27
Sanitary problems in Madras ...	27
English and Indian Sanitary engineering ...	31
Note on sanitation in India ...	33
Dust prevention ...	34
Exhibition of models of a house suitable for villages and small towns, a typical section of an infiltration gallery, wells, house connections and fly-proof latrines	35

URBAN WATER-SUPPLIES.

Monsoon condition of the Hooghly river ...	35
Removal of silt for purification of river water-supplies ...	36
Mechanical filters ...	37
Jewell filter at Naini Tal ...	39
Infiltration galleries ...	40
The Puech-chabal system of water filtration ...	41
Tube-wells ...	42
Artesian and sub-artesian supplies of water in Guzerat ...	42
The financing of water-supply and drainage schemes ...	44

WATER ANALYSIS.

	Page.
Recent researches in the matter of water analysis	49
Analysis of the water-supply of Calcutta	50
Analysis of potable waters in the tropics	50
Bacteriological examination of water	51
Examination of samples of water	52
Speech by Colonel Firth on the bacteriological examination of water ...	52

VISIT TO GUINDY.

Vaccine lymph	53
Demonstrations in Microbiology	54
Dracontiasis	54
Experimental sand and mechanical filters	54
Sleeping sickness	55
Inspeetion of the Madras city water works	57

CHOLERA.

The epidemiology of cholera	57
The occurrence of the cholera vibrio in the biliary passages	58
An investigation of cholera convalescents and contacts in India	59
An investigation of an epidemic of cholera caused by a 'carrier'	60
Observations on disinfection in cholera	60
Effect of pipe water-supplies on cholera	61
Some practical points in dealing with epidemics of cholera	62
Measures for dealing with cholera epidemics	63
Bacteriology of the cholera vibrio	63
Cholera vibrio	65
Discussion on papers relating to cholera	65

MISCELLANEOUS PAPERS ON HYGIENE.

Popular errors in hygiene	67
Conservancy in the tropics	67
Infantile mortality	67
Epidemic fever in Calcutta	67

FEVERS AND INFECTIOUS DISEASES.

Dysentery	68
Diarrhœa in Poona	68
Tuberculosis	69
Malta fever	70
Enteric fever in India	72

SEWAGE AND REFUSE DISPOSAL.

Poona experimental sewage installation	73
Percolating filters	74
Colombo drainage scheme and sewage treatment	74
Night soil disposal and associated fly breeding	75
Disposal of rubbish in Madras	75
The sullage farm at Agra	77
Sullage treatment at Lucknow	78
Reclamation of low lying lands with refuse	78
Colombo refuse destructor	79

VISIT TO CONJEEVERAM.

Conjeeveram water-works	80

PROBLEMS CONNECTED WITH THE MILK SUPPLY.

PAGE.

The utilisation of a continuous temperature of 50° C. for the preservation of the potability of milk 83
Milk supply of Calcutta 83
Milk supply of towns 84
Some practical points in the Indian milk problem 85

VITAL STATISTICS.

Mortality in the Cossipore-Chitpore municipality 87
Vital statistics, Bengal 87

EDUCATION AND HYGIENE.

Education in public health 88
Medical inspection of school children 93

RURAL SANITATION.

Sanitation of villages and small towns 94
Rural sanitation in Bengal 94
Village sanitation 95

ADULTERATION OF FOOD AND DRUGS.

Inspection of food and drugs 95

RURAL WATER-SUPPLIES.

Madras 96
Bombay 97
Bengal 98
United Provinces 98
Punjab 100
Burma 100
Bihar and Orissa 103
Central Provinces 103
Assam 103

RESOLUTIONS AND CONCLUSION.

His Excellency Lord Pentland's speech 105
The President's reply 105
Resolutions 107
Conclusion 112
Index 113

Prefatory note.

In addition to this volume there are three separate volumes containing papers read at the Sanitary Conference on Hygiene (Volume II), Research (Volume III) and Engineering (Volume IV)

(*g*) "A note on the fleas infesting the Mus Rattus in Naini Tal and Mussoorie."—Captain H. Ross, I.M.S.

(*h*) "The prevention of plague."—Captain W. C. Ross, I.M.S.

(*i*) "The absence of a 'Negative phase' after inoculation with plague prophylactic."—Captain W. D. H. Stevenson, I.M.S.

(*j*) "Plague preventive measures."—Major W. Glen Liston, I.M.S.

Section B.

1. "The Simla hydro-electric scheme."—A. S. Montgomery, Esq.
2. "Sanitary problems in Madras."—W. Hutton, Esq.
3. "Some differences between English and Indian sanitary engineering practice."—G. B. Williams, Esq.
4. "Note on sanitation in India."—C. N. Mandy, Esq.
5. "Note on dust prevention."—C. L. Cox, Esq.
6. "The prevention of dust in Indian city roads and streets."—E. P. Richards, Esq.
7. Exhibition of some models of sanitary works in Madras by J. M. Lacey, Esq.
8. Exhibition of a modal of a fly-proof latrine by Major H. A. Forbes-Knapton, I.M.S.
9. Exhibition of a modal of a fly-proof latrine by V. D. Pillai, Esq.

Afternoon, 2-30 p.m. to 4-30 p.m., both sections.

Urban water-supplies.

(*a*) "Report on the monsoon condition of the Hooghly river and the results of experiments on silt removal."—Major W. W. Clemesha, I.M.S.

(*b*) "The removal of silt for purification of river water-supplies."—C. H. West, Esq.

(*c*) "Mechanical filters."—Major W. W. Clemesha, I.M.S.

(*d*) "Mechanical filters for town water-supply."—Mr. V. Rangasawmy Iyengar.

(*e*) "A note on the Jewell filter at Naini Tal."—Captain C. L. Dunn, I.M.S.

(*f*) "Infiltration galleries, Madras presidency."—J. M. Lacey, Esq.

(*g*) "Infiltration galleries"—W. Hutton, Esq.

(*h*) "The Puech-Chabal system of water filtration."—C. H. West, Esq.

(*i*) "Tube-wells as a source of public water-supply."—T. A. Miller Brownlie, Esq.

(*j*) "Artesian and sub-artesian supplies of water in Guzerat."—Mr. Nanjundayya Belvadi.

Third day, 13th November.

Forenoon, 10-30 a.m. to 12-30 p.m., both sections.

1. The financing of water supply and drainage schemes.—Resolution by the Government of Bombay, No. 4202, dated the 2nd July 1912, on the subject.

2. Water Analysis.

(*a*) "Recent researches in the method of water analysis."—Major W. W. Clemesha, I.M.S.

(*b*) "Water-supply of Calcutta, its present system of analysis and its disadvantages."—Rai Bahadur Kailas Chandra Bose, C.I.E.

(*c*) "Water analysis in the tropics with special reference to the adoption of standard methods in the collection and examination of samples."—Dr. F. Maitland Gibson.

(*d*) "The bacteriological examination of water."—Military Assistant Surgeon E. C. R. Fox, I.S.M.D.

(*e*) "The examination of samples of water sent to a distant laboratory."—Military Assistant Surgeon E. C. R. Fox, I.S.M.D.

Afternoon, 3 p.m. to 7 p.m.

Visit to the King Institute at Guindy.

Section A.

1. The manufacture, storage and distribution of vaccine lymph.
2. "Vaccine lymph: its production, preparation and preservation."—Major W. F. Harvey, I.M.S.
3. Microscopical and practical demonstrations in microbiology by Captain W. S. Patton, I.M.S.
4. "Dracontiasis"—Dr. D. A. Turkhud.
5. "Sleeping Sickness."—Captain F. P. Mackie, I.M.S.

Section B.

1. Experimental sand and mechanical filters, King Institute, Guindy.—W Hutton, Esq.
2. The disposal of the sewage at the Institute.

Fourth day, 14th November.

Morning, 7·30 a.m. to 10 a.m., both sections.

Inspection of the Water Works, Madras city, with a paper by J. W. Madeley, Esq.

Forenoon, 11 a.m. to 1 p.m., both sections.

1. Cholera.

(*a*) "The epidemiology of cholera."—Captain W. C. Ross, I.M.S.

(*b*) "An investigation on the occurrence of the cholera vibrio in the biliary passages."—Major E. D. W. Greig, I.M.S.

(*c*) "An investigation of cholera convalescents and contacts in India."—Major E. D. W. Greig, I.M.S.

(*d*) "An investigation of an epidemic of cholera caused by a 'carrier'."—Major E. D. W. Greig, I.M.S.

(*e*) "Observations on disinfection in cholera."—Major E. D. W. Greig, I.M.S.

(*f*) "The effect of pipe water supplies on the reduction of cholera in urban areas."—Major S. A. Harriss, I.M.S.

(*g*) "Some practical points in dealing with epidemics of cholera."—Major H. A. Forbes Knapton, I.M.S.

(*h*) "Proposed measures for dealing with cholera epidemics in the United Provinces."—Captain C. L. Dunn, I.M.S.

(*i*) "The bacteriology of cholera and its relation to the spread of the disease from the point of view of the Health Officer."—Dr. J. A. Turner.

(*j*) "Notes on vibrios isolated from various sources in Bombay during the recent outbreak of cholera."—Captain T. H. Gloster, I.M.S.

2. Miscellaneous papers on hygiene.

(*a*) "Three popular errors in hygiene."—Captain W. C. Ross, I.M.S.

(*b*) "Conservancy in the tropics, an important work of the Health Department."—Dr. A. G. Newell.

(*c*) "Infantile mortality, its cause and its prevention."—Rai Bahadur Kailas Chandra Bose, C.I.E.

(*d*) "The outbreak of epidemic fever in Calcutta."—Rai Bahadur Kailas Chandra Bose.

Afternoon, section A.

Fevers and infectious diseases.

(*a*) "Dysentery, problems and proposals."—Major W. F. Harvey, I.M.S., and Captain J. Cunningham, I.M.S.

(*b*) "Interim report on the causes of Diarrhœa in Poona."—Captain J. Morison, I.M.S.

(*c*) "The prevention of tuberculosis in Madras."—Dr. P. S. Chandra Sekhar.

(*d*) "Tuberculosis and its relation to public health."—Lieutenant C. J. Fox, I.S.M.D.

(*e*) "Reflections and proposals resulting from an enquiry into the causes of three epidemics of Malta fever occurring in the 37th Lancers and 10th Lancers in India."—Captains T. G. F. Paterson and H. C. Brown, I.M.S.

(*f*) "Enteric fever in India—an account to date of the results obtained from the practical working of the recommendations of the Enteric Fever Research Committee of the Government of India (1906—08)."—Major E. D. W. Greig, I.M.S.

Section B.

1. Sewage and refuse disposal.

(*a*) "Preliminary paper on the Poona experimental sewage installation."—Major F. H. G. Hutchinson, I.M.S.

(*b*) "Percolating filters."—Major F. H. G. Hutchinson, I.M.S.

(*c*) "Note on the Colombo drainage scheme and sewage treatment works."—C. L. Cox, Esq.

(*d*) "Night soil disposal and associated fly breeding."—Major S. A. Harriss, I.M.S.

(*e*) "The disposal of rubbish by means of small incinerators in the City of Madras."—Dr. W. R. MacDonald.

(*f*) "Note on the sullage farm at Agra."—Major S. A. Harriss, I.M.S.

(*g*) "Note on sullage treatment at Lucknow."—A. W. Standley, Esq.

(*h*) "Is it right to reclaim low lying lands and swamps with refuse in a crowded city ?"—Dr. D. B. Master.

(*i*) "Note on a Colombo refuse destructor."—C. L. Cox, Esq.

Fifth day, 15th November.

All day, 7 a.m. to 2 p.m., both sections.

Visit to Conjeeveram to inspect the infiltration gallery and pumping station there. A paper on the water-supply of Conjeeveram by Hormusji Nowroji, Esq.

Sixth day, 16th November.

Forenoon, 10-30 a.m. to 12-30 p.m., both sections.

1. Milk supply :—

(*a*) "The utilisation of a continuous temperature of 50° C. for the preservation of the potability of milk."—Military Assistant Surgeon G. Mackey, I.S.M.D.

(*b*) "Milk supply of Calcutta."—Rai Bahadur Kailas Chandra Bose, C.I.E.

(*c*) "Note on the milk supply of towns."—Major S. A. Harriss, I.M.S.

(*d*) "Some practical points in the Indian milk problem and how they may be tackled."—Dr. A. G. Newell.

2. Vital Statistics :—

(*a*) "Mortality in Cossipore-Chitpore."—Bepin Behari Brahmachari, Esq.

(*b*) "Vital Statistics, Bengal."—Dr. C. A. Bentley.

3. "Popular education in Public Health."—Major T. G. N. Stokes, I.M.S.

4. "The medical inspection of school children in India."—Dr. S. Amritaraj.

5. Village Sanitation :—

(*a*) "A Note on the sanitation of small towns and villages."—The Honourable Khan Bahadur Syed Mahdi Shah.

(*b*) "Rural sanitation in Bengal."—Moti Lall Ghose, Esq.

(*c*) "Village Sanitation."—Syed Zahiruddin, Esq.

6. "Inspection of food and drugs in relation to Public Health."—Dr. T. M. Nair.

7. Rural Water supplies.

Notes by the different Sanitary Commissioners as to what has been done in their respective provinces.

Afternoon, 2-30 p. m. to 4-30 p.m., both sections.

Resolutions.

FIRST DAY, NOVEMBER 11.

FORENOON'S PROCEEDINGS.

The second All-India Sanitary Conference opened its session at the Council Chamber, Fort St. George, Madras, at 10-30 A.M. (11th November 1912). The Honourable Sir Spencer Harcourt Butler, K.C.S.I., C.I.E., I.C.S., Member of the Governor-General's Council in the Department of Education, presided, and the following delegates were present:—

India.—The Honourable Mr. L. C. Porter, C.I.E., I.C.S., Secretary to the Government of India, Department of Education; the Honourable Surgeon-General Sir Charles Pardey Lukis, K.C.S.I., M.D., F.R.C.S., I.M.S., Director-General, Indian Medical Service; Major J. C Robertson, M.A., B.Sc., M.B., D.P.H., I.M.S., Sanitary Commissioner with the Government of India; Kunwar Maharaj Singh, M.A., Barrister-at-Law, Assistant Secretary to the Government of India, Department of Education; Major W. F. Harvey, M.B., D.P.H., I.M.S., Officiating Director, Central Research Institute, Kasauli; Captain A. G. McKendrick, M.B., I.M.S., Officiating Secretary to the Director-General, Indian Medical Service (Sanitary); Major E. D. W. Greig, M.D., D.Sc., I.M.S., Officer on special duty in connection with the investigation of cholera; Captain F. P. Mackie, M.B., F.R.C.S., I.M.S., Officer on special duty in connection with the investigation of *kala azar*; and Dr. V. T. Korke, Officer on special duty in connection with the investigation of *kala azar*.

Madras.—The Honourable Surgeon-General W. B. Bannerman, C.S.I., M.D., D.Sc., I.M.S., Surgeon-General with the Government of Madras (Vice-President for Section A); Captain W. A. Justice, M.D., D P.H., I.M.S., Sanitary Commissioner for Madras (Secretary to Section A); Mr. W. Hutton, A.M.I.C.E., Sanitary Engineer, Madras (Vice-President for Section B); Dr. F. Maitland Gibson, M.B., B.Sc., Director of the King Institute, Guindy; Captain W. S. Patton, M.B., I.M.S., Officer on special duty in connection with the investigation of *kala azar*; Captain F. W. Cragg, M.D., I.M.S., Officiating Assistant Director, King Institute, Guindy; Mr. J. M. Lacey, B.C.E., A.M.I.C.E. of the Public Works Department, Madras; Dr. W. R. MacDonald, M.B., CH B., B.HY., D.P.H., Health Officer, Corporation of Madras; Mr. J. W. Madeley, M.A., M. Inst. C.E., M. Am. Soc. C.E., etc., Special Engineer, Corporation of Madras; Mr. E. P. Richards, M.I.C.E., Chief Engineer, Calcutta Improvement Trust; Dr. P. S. Chandra Sekhar, B.A., M D., Assistant Professor of Hygiene and Bacteriology, Medical College, Madras; Lieutenant-Colonel C. Donovan, B.A., M.D., B. Ch., B.A.O., F.L.S., F.E.S., I.M.S., Surgeon, Fourth District, Madras; Captain O. A. R. Berkeley Hill, M.D., I.M.S., Officiating Deputy Sanitary Commissioner, Madras; and Dr. T. M. Nair of Madras.

Bombay.—The Honourable Mr. G. S. Curtis, Commissioner of Central Division, Bombay Presidency; the Honourable Mr. J. P. Orr, C.S.I., I.C.S., Chairman, City of Bombay Improvement Trust; Mr. E. G. Turner, I.C.S., Officer on special duty in connection with the development of Salsette; Major H. A. Forbes Knapton, I.M.S., Officiating Sanitary Commissioner, Bombay; Mr. Nanjundayya Belvadi, B.A., L.C.E., Sanitary Engineer, Bombay; Mr. C. N. Mandy, Executive Engineer, Poona drainage and water-supply; Major F. H. G. Hutchinson, M.B., C.M., D.P.H., I.M.S., Officer on special duty in connection with the Experimental Sewage Installation in Poona; Major W. G. Liston, M.D., D.P.H., I.M.S., Director, Bombay Bacteriological Laboratory; Dr. J. A. Turner, M.D., D.P.H., Executive Health Officer, Bombay Municipality; and Dr. Dinsha Bomanji Master, L.M.S., of Bombay.

Bengal.—Major Leonard Rogers, C.I.E., M.D., F.R.C.P., F.R.C.S., I.M.S., Professor of Pathology, Medical College, Calcutta, and Bacteriologist to the Government of Bengal; Major W. W. Clemesha, M.D., D.P.H., I.M.S., Sanitary Commissioner, Bengal; Dr. C. A. Bentley, M.B., D.P.H., Special Deputy Sanitary Commissioner for Malaria Research in Bengal; Mr. G. B. Williams, Sanitary Engineer, Bengal; Mr. A. J. G. Maflin, Assistant Sanitary Engineer, Bengal; Rai Bahadur Kailas Chandra Bose, C.I.E., L.M.S., of Calcutta; Mr. Bepin Behari

Brahmachari, L.M.S., Health Officer, Cossipur-Chitpur Municipality, and Mr. Moti Lal Ghose, Editor of the *Amrita Bazar Patrika*, Calcutta.

United Provinces.—Major S. A. Harriss, M.B., C.M., D.T.M., D.P.H., I.M.S., Sanitary Commissioner, United Provinces; the Honourable Rai Bahadur Ganga Prasad Varma of Lucknow; Major J. D. Graham, M.B., D.T.M., I.M.S., Special Officer on malaria duty in the United Provinces; Mr. A. W. E. Standley, Officiating Superintending Engineer, II Circle, Irrigation Works, United Provinces; Captain H. Ross, M.B., I.M.S., Chief Plague Officer, United Provinces; Captain C. L. Dunn, I.M.S. Deputy Sanitary Commissioner, United Provinces; and Mr. C. H. West, Sanitary Engineer, United Provinces.

Punjab.—Lieutenant-Colonel E. Wilkinson, F.R.C.S., D.P.H., I.M.S., Sanitary Commissioner, Punjab; the Honourable Khan Bahadur Syed Mehdi Shah of Gojra; Lieutenant-Colonel S. Browning Smith, I.M.S., Chief Plague Medical Officer, Punjab; Dr. A. G. Newell, M.D., D.P.H., Health Officer, Lahore; Mr. A. S. Montgomery, Sanitary Engineer, Punjab; and Mr. T. Miller Brownlie, Municipal Engineer, Amritsar.

Burma.—Major C. E. Williams, M.A., M.D., B.C., D.P.H., D.T.M., I.M.S., Sanitary Commissioner, Burma; Major N. P. O'Gorman Lalor, M.B., B.Ch., B.A.O., D.P.H., I.M.S., Deputy Sanitary Commissioner, Burma; Dr. J. B. Stephens, M.R.C.S., L.R.C.P., D.P.H. Municipal Health Officer, Rangoon; and Mr. E. Gabbett, V.D., M.I.C.E., M.R.S.I., Sanitary Engineer, Burma.

Bihar and Orissa.—Captain W. C. Ross, M.D., D.P.H., F.C.S., I.M.S., Officiating Sanitary Commissioner, Bihar and Orissa; Mr. G. W. Disney, Sanitary Engineer, Bihar and Orissa; and Moulvi Syed Zahir-ud-din, Vice-Chairman, District Board of Patna.

Central Provinces.—Major T. G. N. Stokes, B.A., M.B., B.Ch., B.A.O., L.M., D.T.M. & H., I.M.S., Sanitary Commissioner, Central Provinces; Major L. W. S. Oldham, R.E., A.M.I.C.E., Sanitary Engineer, Central Provinces; and Khan Bahadur Manekji Merwanji Mullah of Balaghat.

Assam.—Captain T. C. McCombie Young, M.B., D.P.H., I.M.S., Deputy Sanitary Commissioner, Assam; Rai Sahib Dandadhar Barua of Golaghat, Sibsagar, and Dr. Valentine, Medical Officer, Tea Gardens, Assam.

Ceylon.—Dr. G. J. Rutherford, M.R.C.S., L.R.C.P., Assistant Principal Civil Medical Officer, Ceylon; Dr. W. Marshall Phillip, M.B., Municipal Medical Officer of Health, Colombo; and Mr. C. L. Cox, A.M.I.C.E., City Sanitation Engineer, Colombo.

Mysore.—Mr. V. Rangasawmy Iyengar, Superintending Engineer of the Southern Circle, Mysore State, and Dr. S. Amritaraj, L.R.C.P. & S., D.P.H., Health Officer, Civil and Military Station, Bangalore.

Hyderabad.—Mr. V. Devasikamani Pillai, Sanitary Engineer, Hyderabad.

The President's opening speech.

The President addressed the delegates as follows:—

"GENTLEMEN,

In welcoming you to our second all-India Sanitary Conference, I desire, on behalf of the Government of India, to thank the Government of Madras for the arrangements which they have made for us, and the various local Governments and Administrations, and yourselves for your presence here. The experience of the past twelve months has, I think, demonstrated the utility of conferences of this kind. Ideas and interests have been quickened on all sides and there are signs of a sanitary awakening in India, of the dawning of an age of greater attention to public health. Not the least hopeful sign is the number of applications which have been received from professional men and members of the general public for permission to attend our meetings. Many of these we should have liked, but have for reasons of space been unable to grant. Our body is already large. I hope that it is thoroughly representative. We specially welcome the presence of non-official representatives of the different provinces as an augury of that

co-operation between experts and laymen without which, as I pointed out last year, it will be difficult, if not impossible, to achieve any widespread sanitary progress in this country. You will observe certain changes in our procedure this year. In view of the number of papers submitted for consideration, and the importance of the subjects dealt with, it has been decided to extend the Conference from two to six days, and to divide it into two sections, medical and engineering, so as to enable both research workers and practical sanitarians to derive the fullest benefit from the discussions on their respective subjects, without unduly prolonging the session.

Since we last met, two important administrative measures have received the sanction of the Secretary of State, namely, the revival of the appointment of Sanitary Commissioner with the Government of India, and the introduction of a scheme for the reorganisation of the Sanitary services. Certain changes have been made in the duties of the Sanitary Commissioner. Experience has shown, on the one hand, that his usefulness depends largely on his touring freely, and, on the other hand that bacteriological and research work cannot be divorced from the practical side of medicine, without great waste of power and opportunity. It has been arranged, therefore, to relieve him of much of the office work that has hitherto tied him to headquarters, by amalgamating the office establishments of the Sanitary Commissioner and the Director-General, Indian Medical Service, and to hand over bacteriological and research work to the latter officer. The Sanitary Commissioner, however, remains the final authority on all technical sanitary matters, and as such has power as formerly to correspond direct with the Government of India. These arrangements will secure a high measure of practical efficiency and I take this opportunity to observe that we are indeed fortunate in starting them with officers so able, zealous, and tactful as Surgeon-General Sir Pardey Lukis and Major Robertson.

The scheme for the reorganisation of the Sanitary Services, to which I refered in my speech last year continues a progressive policy of decentralisation by giving to local Governments power to select their own Sanitary Commissioners under certain conditions. It also provides for the creation of eight additional appointments of Deputy Sanitary Commissioners, two each for Madras and the United Provinces, and four for the reconstituted Provinces of Bengal and Bihar and Orissa. These appointments will no longer be reserved for officers of the Indian Medical Service, and Indians possessing the necessary qualifications will be eligible for them. Provision is also made for the appointment of Health Officers of the first class for larger municipalities, and of the second class for smaller towns. Officers of the first class will, for the present, be required to possess a British Diploma in Public Health, but this condition will be removed as soon as arrangements can be made in India for the necessary training. It is hoped that a post-graduate class for the D. P. H. of the Calcutta University will shortly be opened in connection with the recently sanctioned School of Tropical Medicine at Calcutta. In order to assist local Governments to establish this trained service, the Government of India have offered to grant an annual subsidy to those Governments which cannot find the money from provincial funds, to the extent of the entire cost of the additional Deputy Sanitary Commissioners, and half the cost of the Municipal Health Officers. It is hoped that local Governments will then be able to help municipal bodies in the organisation of a service of trained Sanitary Inspectors on a system similar to that in force in Madras, and in the improvement of the subordinate staff of the conservancy establishments. In these ways the foundations are being laid of a modern and up-to-date organisation which will expand in response to the demands that will be made upon it.

Under the auspices of the recently constituted Research Fund, an exhaustive enquiry into various problems connected with cholera and *kala azar* has been conducted by selected medical officers, and several interesting and important discoveries have been made and will be communicated to you in the course of the Conference. Also a number of medical officers and subordinates, after a careful training under Professor Howlett at Pusa, have been detailed for carrying out stegomyia surveys in all our chief ports, with a view to the destruction, or reduction to non-dangerous numbers, of this mosquito, which is known to be the carrier of yellow fever. Major James, who was deputed to Panama to study that

disease in its endemic area, is expected back in India at the end of this month, and he will be able to give us the benefit of his special and fresh experience in our preventive campaign against yellow fever, before he proceeds on deputation to Ceylon for a period of one year under the Ceylon Government. It is proposed, on the completion of the *kala azar* and cholera enquiries, to take up the investigation of relapsing fever, elephantiasis, dysentery, and the various types of pneumonia, in connection with all of which many obscure points require elucidation.

I now come to the disposal of the grant of Rs. 5 lakhs for anti-malarial measures. This sum is primarily intended for the execution of worked out anti-malarial projects. These may have reached one or other of two distinct and separate stages :—

(i) Initial and detailed local enquiries into the conditions causing the malaria ; and

(ii) the practical application of this knowledge towards ameliorating or removing these conditions.

Grants-in-aid will in future be allotted only to schemes which have reached the second stage. During the current year grants have been given to projects which are still in the first stage, and the following sums have been disbursed :—

	Rs.
Madras, for malarial enquiry in Ennore	28,000
Bombay, malarial investigations in Sind and the Kanara district	21,380
Anti-malarial measures in Bombay City	50,000
Bengal, experimental jungle clearing	50,000
United Provinces, anti-malarial schemes in Saharanpur, Nagina and Kosi	1,80,000

In Bombay and the United Provinces alone was any big scheme ready. In other provinces several projects are now under consideration. These experiments will, it is hoped, result in much valuable knowledge for the benefit of the peoples of India.

Turning now to the agenda, perhaps the most important items are town-planning and the opening up of congested areas—subjects, I may say, very near to the heart of the Secretary of my department, Mr. Ludovic Porter, whose enthusiasm and ability I desire heartily to acknowledge. The evils of overcrowding and defective ventilation which exist in all great cities are intimately connected with high death-rates, and especially with the spread of tuberculosis. The Government of India have recently addressed local Governments on the subject of the formation of anti-tuberculosis societies, but no societies of the kind and no preventive measures will check the ravages of this terrible scourge, unless effective measures are taken to improve the housing of the masses, to open out existing insanitary areas and to insure that all future town expansions are planned on scientific lines. These questions are fully treated in the important papers for discussion to-day on town-planning by Mr. Turner, and on light and air in dwellings in Bombay by Mr. Orr. We are particularly grateful to these officers for attending the Conference, for they can speak with a knowledge and experience which few in India possess ; indeed, they may be called pioneers in India of the new science of town-planning. You will not expect me to offer any remarks on the various scientific and technical papers which will be read before the different sections, but I wish to draw special attention to the important discussion on rural and urban water-supplies which will occupy the afternoon of the second day, and to the papers on travelling dispensaries which will be read by Captain H. Ross and Surgeon-General Bannerman. I confess that I can conceive no object more humane, no measure better calculated to brighten the lives of the people and reduce the mass of human suffering than the provision of a pure and sufficient water-supply, where such does not exist. We are informed that travelling dispensaries have proved a great boon not only in bringing medical and surgical relief within reach of the rural population, but also in winning the confidence of the people.

It is no accident or idle chance that education and sanitation are united under the same department of the Government of India. Our first and signal objective

is to educate the people as to the value and necessity of measures for protecting them in their homes and their lives, and those dearest to them from the ravages of plague, malaria, cholera and other communicable diseases, and all the miseries which follow in their train. " Day and night, " wrote Hesiod long ago, " diseases run to and fro amongst men at their will." *Automatoi phoitosi* ! That was the old idea. That is still the idea of the vast majority in India to-day. We are here to preach another doctrine, to enforce another view. We believe, and we have proofs of our belief, that the courses of diseases, though mysterious, are not capricious but defined by conditions which are ascertainable. In this faith we are building up a school of research in India, which will soon rank with the first in the world. Fortified by the results of research we can leave the future, with confidence, to preventive medicine and preventive sanitation, but we must have the people with us, or we can do but little. In recent years, by precept and example, the Governments in India have done much to penetrate the mists of ignorance and prejudice which hide from the masses the blessings of sanitary science, the science of new and better and happier conditions of society. In the last two years the Imperial Government has made grants for sanitation aggregating more than a million sterling, and in its anxious solicitude for the health and comfort of the people that Government has also recently decided to institute, in concert with local Governments, a comprehensive enquiry into the possibility of improving sanitary arrangements along pilgrim routes and at pilgrim centres. This philanthropic energy has not been in vain. The demands upon us are growing apace. In increasing numbers people want things done, and when men want things done they must, in these days, turn to experts to show the way. You, I know, will not fail, gentlemen, when the call for the expert resounds throughout this ancient land; and, meanwhile, you will push forward the work to which you have laid your hands with dauntless patience and indefatigable zeal."

TOWN-PLANNING,

CONGESTED AREAS AND BUILDING BYE-LAWS.

Town-Planning.

Mr. Turner, Special Officer, Salsette building sites, Bandra, read a paper on "Town-Planning" (Volume II) in one of the rooms of the Government Maternity Hospital, where the President and the members of the Conference drove from the Council Chamber after the conclusion of the President's address. Mr. Turner illustrated his paper by exhibiting diagrams with the aid of lantern slides thrown on canvas.

The following is a resumé of the paper.

The lines on which town-planning work is being considered in Bombay is really a combination of the English principle of "betterment" and the German principle of redistribution.

Redistribution gives power to alter the shape of plots so as to render them more suitable for building plots. It is especially necessary in town-planning in a country where holdings are mostly small, and irregular in shape. The power to cut plots from larger holdings and allot them to owners dispossesed of their fields by the advent of roads and other public sites, allows the capital cost of the scheme to be reduced by the value of the plot allotted. The owner of the holding from which the allotted plot is carved, will have his contribution for betterment reduced by the cash value of such allotted plot. The power to redistribute will be held in reserve and used as much or as little as is found expedient. The wishes of holders should be followed as far as consistent with the objects of the scheme. Examples are given in the paper by diagrams of various alternative redistributions of plots.

Betterment enforces contributions from owners towards the cost of a scheme in proportion to the extent to which their land is bettered by the completed scheme. It is reasonable that holders should contribute some portion of their betterment towards constructional and other expenses, but no more should be taken than is necessary for actual expenses. The proportion to be taken should

be limited as in England to one-half, and if any more is required, it must be provided from other sources, general taxation, etc.

Credit and debit.—By a method of credit and debit, the amount of capital necessary to be raised is minimized. With each holder an account is opened, on the credit side of which will be the decrease in the value of his plot due to rearrangement, and on the debit side the portion of his betterment which is levied for expenses. The balance on the debit side will be levied from him, on the credit side paid to him. Instead of paying holders in cash for land they give up and afterwards levying a contribution from them, the difference of these two items will be levied from, or paid to, them, and so the amount of capital to be raised materially diminished.

Betterment.—Method of calculating.

This may be done, as in England, after all the constructional works have been finished. Under a system of redistribution of plots there are advantages in estimating at the same time as the original and final plots allotted are valued, *i.e.*, before works are started. This allows of a set off being made in each account and provides the local authority with an immediate security on which to raise loans. With a system of prevaluation power should be given to the majority of owners or to the local authority to demand a revised valuation after a fixed period.

Procedure.—(*a*) The local authority will publish a notification of intention to plan a certain area defined by boundaries and showing existing and proposed main roads.

(*b*) Owners will be fully consulted as to any redistribution that may be necessary.

(*c*) A block plan and scheme will then be prepared showing details and objections invited.

(*d*) After consideration and alterations, the local authority will submit scheme and objections received to the controlling authority.

(*e*) The controlling authority will appoint an independent arbitrator, to be an expert valuer who will draw up the final scheme and plan as sanctioned.

(*f*) He will award compensation payable for extinction of rights or any property injuriously affected, and will calculate the dues leviable from every holder in accordance with his valuations.

(*g*) The local authority will then notify the final scheme and date from which it will take effect.

Transfer of rights.—So far as possible the rights of lessees or mortgagees of original plots should be transferred in the same or a conveniently modified form to new plots, and compensation paid to any one injuriously affected. Agricultural leases should not be transferred without consent of all parties. The arbitrator will decide questions of compensation for transference of rights, and decide what rights shall be transferred to the rearranged plots. On the day the scheme takes effect the old rights will be extinguished, and the new rights take effect.

The President said that any members were welcome to put questions to Mr. Turner.

Rai Bahadur Ganga Prasad Varma asked who would be the arbitrator and whether the local authority would appoint him.

Mr. Turner replied that the arbitrator would be an independent valuer and appointed by the controlling authority.

Dr. Master asked whether there was any right of appeal from the finding of the arbitrator.

Mr. Turner answered that there was no appeal allowed in England and that he preferred to follow the English practice.

Dr. Nair asked what were the data for estimating betterment? He thought that the estimates would be purely arbitrary if the betterment was estimated before the completion of the works. He preferred to have estimates for betterment after the works had been completed.

AFTERNOON'S PROCEEDINGS.

The afternoon session opened at 2-30 P.M. The President called upon the Honourable Mr. Orr to read his paper on "Light and Air in dwellings in Bombay" (Volume II.)

Light and air in dwellings in Bombay.

Mr. Orr, in the course of his paper referred to the conditions at Bombay, details of which he gave. He thought it desirable that improvements should come from the people themselves and spoke of the hopelessness of continuing methods of wholesale acquisition and demolition. The Trust, he said, had only touched 10 per cent. of the congested areas, in spite of all their exertions. The remedy lay, he thought, in the provision of light and air by the application of the 63½ degrees standard to every room in every house. The importance of this in a place like Bombay, where 85 per cent. of the population lived in one tenement was enormous. The 63½ degree standard meant that there should be external air space outside each room open to the sky extending to a distance measured horizontally from the room wall of at least half the height of the top of the opposite house above the floor of the room. The angle so prescribed would strike the floor at an angle of 63½ degrees. Partial remedies applied to isolated buildings were of no advantage. The remedy must be supplied universally to old buildings when rebuilt or materially altered as well as to new buildings. The first remedy was the direct prohibition of the use of any room for human habitation inadequately lighted and ventilated, and, secondly, the wiping out by degrees of all rooms of that description. The result of wholesale acquisition and demolition was to drive out the population to other overcrowded quarters and to force up rents. When houses were rebuilt after such demolition the same class did not come back, but a superior class. It was better to pull down parts of insanitary blocks and thus to render the remainder more sanitary. The effect of the proposals put forward in the lecture would be to dishouse 20 per cent. of the population but there were ample empty spaces available for housing them.

The main lessons to be deduced from past experience and investigation were as follows :—

(1) Partial improvement was of no good. Some of the houses which had been condemned as unfit for human habitation had been rebuilt in accordance with existing municipal bye-laws but these did not go far enough. There was necessity for a standard to be fixed which must rigidly be adhered to. No reduction in the 63½ degree rate should be allowed at any rate in new houses, though a period of grace, say 5 years, might be allowed in old houses.

(2) Building operations must be controlled everywhere so that matters did not become worse.

(3) They must deal with rooms as units not with houses or blocks of houses.

(4) An absolute veto was necessary on the occupation of rooms which did not comply with the standard decided upon. After a period of, say five years, all such rooms should be closed.

(5) There must be removal of obstructive dwellings and consequent admission of light and air to surrounding houses. In that way the evils of overcrowding would also be reduced.

(6) Window area must bear some proportion, say 1 to 7, to the floor area. Otherwise it would lead to the evil of long deep rooms lighted by one window at the end.

In England the provisions for removing obstructive houses and demolishing houses unfit for human habitation, contained in the Housing of the Working Classes Act and Town Planning Act of 1909, had been widely applied at an

extraordinarily cheap rate in Birmingham and other towns. He gave the following details of what had been done in some large towns in England.

Work done under the Housing of the Working Classes Acts of 1890 and 1909—

Hull.—(*a*) In the last half of 1911—1,279 houses inspected under section 17 of the Housing of the Working Classes Act, 1909—71 demolished as unfit for human habitation.

(*b*) From 1898 to 1911—1,108 houses inspected, 788 houses demolished.

Brimingham.—In 5 years to May 1906—1,132 houses rendered habitable, 445 demolished at average cost to Corporation of 2 guineas per house; 77 obstructive buildings removed at average cost of £29 per house; 41 courtyards opened out, 12 acres of ground previously congested have been cleared and made open space.

Birmingham.—To end of May 1908—4,427 houses inspected; 1,050 demolished, 205 obstructive houses removed.

Glasgow.—Extract from report of sub-committee on uninhabitable houses—January 1906.

In 1901 to 1905 the number of properties removed or agreed to be removed at fixed rates or for which closing orders have been granted is 211 containing over 2,000 apartments and displacing over 3,400 persons. The death rate has gradually fallen from 21·1 per 1,000 in 1901 to 17·9 per 1,000 in 1905. In a single word, following on the committee's operations the death rate fell from 42½ in 1901 to 21½ in 1905.

The removal of these properties, which in themselves were unfit for human habitation has besides stopping death on those particular sites also reduced the death rate of the surrounding properties by providing them with better light and a free current of air, thus tending at the same time to combat the spread of consumption, the number of deaths from that disease per annum for the whole city having fallen since 1900 from 1,400 to 1,200.

The difficulty in India was that they were asking owners to go at once from a very low to a reasonably high standard; in England the previous standard was not so low. In England there had nevertheless been violent opposition at first to the Act of 1909, but this was followed by a ready acquiescence. There was a good deal of public spirit in England where the citizens and the houseowners realised what their duty to the nation and children was. The work in big cities was being done by public spirited citizens, who qualified themselves for the work in every possible manner.

Dr. Master ~~referred to the~~ fact that the question was not only a question of sanitation but also of economics and that it was necessary for the Bombay Corporation to consider the financial side also. He admitted that the Improvement Trust did do some good in Bombay but a great many slums still remained untouched. Mr. Orr had himself admitted that eighty per cent. of the population lived in one room tenements and the majority of the rooms were not properly lighted and ventilated. If improved houses were got ready, it would mean that higher rents would be demanded. Mr. Orr had complained of the municipal bye-laws, but he forgot that the bye-laws had been only recently improved. Admitting the necessity of the desired improvements the question would after all reduce itself to rupees, annas and pies. If they extended the operations of the Trust, in the course of a few years, houses would be built on improved lines and the buildings would not be occupied for years to come. The standard of ventilation in England could not be copied at once in Bombay. Prices were rising and unless the income of the people also rose in the same proportion there would be great difficulty in finding tenants for improved houses. The Corporation of Bombay was ready and willing to co-operate with the officials as much as possible, but they had always to consider both sides, *viz.*, the sanitary side and the financial side.

Town improvement in Lucknow.

The Honourable Rai Bahadur Ganga Prasad Varma in introducing his note on "Town-planning and town improvement" (Volume II) gave an account of four town improvement schemes that had been successfully carried out by the Municipal Board of Lucknow. He advocated large State expenditure on improvements and the grant of facilities. He thought that land for new houses should be sold freehold or given on ninety-nine years' leases. He was against levying any rate on unearned increments as people would be unwilling to pay any rate on their property merely for the fact that a new road was going to be constructed at some distance from their holdings. He laid special stress on the fact of having selected officers entrusted with land acquisition work. He thought that Government should encourage philanthropic bodies to form new "bastis" and that capitalists should be persuaded to find money for building sanitary houses. In his experience the people were ready and willing to spend ten rupees for every single rupee spent by the local body on town improvement schemes.

Building bye-laws.

Major Harriss, Sanitary Commissioner, United Provinces, in introducing his paper on "Building bye-laws" (Volume II) referred to the difficulty in enforcing bye-laws and gave instances of bye-laws having been transgressed without adequate penalties. The control of the erection and re-erection of buildings was sought after by members in some municipalities, but in many municipalities members complained of the worry to which they were subjected by their friends and electors to try to obtain some concession or escape from the operations of certain bye-laws in their individual cases. It would be preferable if members were protected from those importunities by delegating their executive powers to an official Chairman or to a Health Officer with whom the individual would have no direct concern. It was with a view to the relief of the members from an invidious position that Health Officers were enrolled in a provincial service in the United Provinces and appeals against their actions could only be made to the Commissioner and the Sanitary Board. He sincerely hoped, therefore, that municipal members would adopt a method of delegating their powers for the control and enforcement of bye-laws.

Town improvement and drainage in India.

Mr. Pillai, Sanitary Engineer, Hyderabad, next read a paper on "Town improvements and drainage in India" (Volume II). He said that proposals for town and village improvements should go hand in hand with proposals for large cities. In every town and village in India they found congested areas and people went on building valuable houses in those areas. Those towns were far beyond the reasonable operation of sanitary rules and regulations and Sanitary Inspectors and reports were very necessary there. There were several methods of improving smaller towns some of which were—

1. Leaving open areas for ventilation by purchasing old unhealthy houses.

2. Building up a new town close by the old and diverting the people to that locality by having all public buildings constructed in that locality.

3. Facilitating transit by extending tram lines to the extreme limits of the thinly-populated area.

4. The introduction of several public bathing houses, latrines and urinals would considerably improve the health of the people as well as their houses.

5. The construction of public schools for children was very essential. It had a great educational value, for the children would be trained to have higher ideas of sanitation when they saw a fine house in the school.

6. Great attention must be given to the health of children by scattering over the whole town small play grounds.

7. As pure air was very essential, Town Improvement Trusts and Village Improvement Trusts must be immediately organized.

8. Surface drains must be immediately built.

Relief of congestion.

Dr. Amritaraj, Health Officer, Civil and Military Station, Bangalore, next introduced his paper on the " Relief of congestion in the Civil and Military Station, Bangalore, and results" (Volume II). He said that attention was first directed to the need of sanitary reform by the periodical recrudescence of plague from 1898 onwards, and though minor improvements were made, the real campaign against congested and insanitary areas commenced in 1906. In this year a thickly-populated area of the native bazaar, known as South Blackpully, was chosen for demolition and reconstruction on improved lines. This area which covered 51·53 acres contained 1,952 houses with a population of a little over 12,000. In selecting houses for demolition, main thoroughfares were avoided and new roads were driven through the worst slums so as to facilitate the circulation of air and open spaces were provided. A large population was necessarily unhoused and to provide accommodation for these people and also to encourage emigration from slum areas, a plot of land of 50·35 acres in extent was acquired and laid out in plots for building purposes. In this area now known as " Fraser Town " all facilities were given for building, but under improved building regulations which are detailed, and up to date, no indigenous case of plague has occurred there. Now a further extension of 47 acres has been acquired, and this is being laid out, and it is hoped that the sale of plots will cover not only the cost of acquisition but also the laying out of roads and drains, water and light and a central park. Various details of the improvement schemes are given and the better health conditions which have resulted are shown in a series of statistical appendices.

Dr. Nair said that he did not want to go into details, but there was one particular idea underlying them all. He would like to have an expression of opinion from the Conference on the following point *viz.*, was a municipality justified in acquiring more land than is absolutely necessary for an improvement and selling the remaining land, after the improvement has been effected, at the enhanced rate caused by the improvement ? This appeared to be permissible in Bombay and Calcutta, but it was not so in some of the local Governments of India. In the opinion of the Madras Government only what was required for the improvements was allowed to be retained and the rest had to be resold to the owner at a price at which it had been bought. If that opinion were generally held, the cost of improvements would fall heavily upon the local bodies, whereas if the land could be retained and sold at the enhanced price, the cost could be easily met by the profits. He would not press the Conference to pass a resolution at that time, but he would like the Conference to pass a resolution on that point on Saturday next.

Rai Bahadur Ganga Prasad Varma said that local bodies have power to acquire land for frontages of new houses. A question was put in the Legislative Council of the United Provinces and that was the opinion they had given in reply.

Mr. Turner pointed out that municipalities in Bombay had power to purchase land outside the plot required for improvements and to resell it at a higher price.

Mr. Orr said he thought it was the policy of the Bombay Improvement Trust to take up more land than was required for improvements. He thought it was fully justified when they considered that if they only took up so much as was required for roads the owners on either side had their land bettered but paid nothing for it. It was because of that that he thought the Municipality should be allowed to take up more than is required for its roads and they would thus get the benefit of a better return for their improvements. He referred incidentally with approval to the circular letters of the Government of India regarding town planning and congested areas (Volume II).

Mr. Bepin Behari Brahmachari asked whether the Corporation could deliberately take more land than was necessary for public utility with the view of making a profit for public works.

Major Clemesha said that he thought that what Dr. Nair was enquiring was whether the Land Acquisition Act in any province would allow of acquiring more land than was required for public purposes. They were not entitled to take more land and resell it under that Act. It was necessary, if that was desired to have a special enactment. It could not be done under the present Land Acquisition Act.

Workmen's dwellings.

Dr. Turner, Executive Health Officer, Bombay, in introducing his paper on the "Housing of the working classes in the large cities in India" (Volume II) said that he had endeavoured to show the urgent necessity there was for the adoption of a Bill in India on similar lines to the Housing and Town Planning Act of 1909 in England, especially with reference to housing of the working classes. A dwelling house means any building used wholly or principally for human habitation. A house is a building under an undivided roof or having two or more roofs connected together by subsidiary roofs. Take Bombay. There are some 37,290 buildings in Bombay. Fifty-three of these contain over 400 persons. There are 166,337 occupied one-room tenements, so no less than 76 per cent of the population live in one-room tenements. Seventy-six per cent of the people in Bombay come within the category of working classes, that is about 760,000. The rent of these rooms is from Rs. 3 to Rs. 5 per mensem and the average wage of this class is Rs. 20 per mensem. The working classes in western cities live under almost identical conditions, that is to say, their habits, customs and mode of living are the same, but in India this is different. The working classes here are made up of different divisions of the backward classes. Each division is governed by its own customs and habits, castes and prejudices, and for this reason there is a necessity for housing each class according to a particular method. In Bombay the working classes may be divided into the low-caste Hindu, the Mahratta, the Muhammadan and the Indian Christian. He had endeavoured to point out what was meant by insanitary conditions, both external and internal, and their influence on the public health. He referred to what he called the most important part of the Housing and Town Planning Act as applied to Indian cities, namely, the erection of workmen's dwellings. What he advocated was that the work-people should be removed from insanitary houses and attic dwellings to areas where fresh air, light and space were available.

Rules for laying out sites and planning model houses for the poorer classes.

Mr. Wood's paper (Volume II) entitled "Simple hygienic rules for the guidance of municipalities in laying out sites and planning model houses for the poorer classes," was taken as read.

SECOND DAY, NOVEMBER 12.

MORNING'S PROCEEDINGS.

INSPECTION OF THE MADRAS CITY DRAINAGE WORKS.

Practically all the Engineering delegates and a good many of the Sanitary delegates attended the inspection of the Madras drainage works in the morning at 7-30 A.M., the total number of visitors being about 40. The President of the Madras Corporation, the Chief Engineer and the Sanitary Engineer to the Madras Government were also present.

Mr. Madeley, Special Engineer to the Madras Corporation, gave (Volume IV) a brief description of the works to be carried out and those that had been carried out, and then conducted the delegates over the works as described below.

The works inspected comprised :—(1) special appliances used in the drainage of Madras City ; (2) works completed ; and (3) works in progress.

The first of the special appliances inspected was a silt catcher at the Napier Park. This is an iron bucket fitted with a diaphragm designed to intercept sand used in washing pots, and earth, sand and stone which get into the ordinary Indian house drains. A silt catcher as used in Madras was shown and its effect in intercepting silt explained. A typical silt and storm-water separator such as those used in Madras on connections from side drains to sewers was also shown, and its method of working explained. The Hassall sewer pipe joint for waterlogged ground had been used in Madras during the last year for the first time in Southern India. The method of making the joint was demonstrated. At the Law College pumping station silt-raisers and screens, etc., which are typical of the similar arrangements with which all the Madras sewage pumping stations will be furnished, were also inspected.

Among the completed works inspected was, first, the Law College pumping station. This is a typical small steam-engine sewage pumping station such as is proposed for the similar steam-pumping stations still to be installed in Madras. At this station for the last six months there has been pumped up to the sewage farm, through a newly laid cast iron main, the drainage of South Georgetown, which formerly ran into the sea and produced considerable nuisance. The new pumping plant consists of three sets of triple expansion Worthington pumping engines furnished with steam by two Babcock and Wilcox boilers. Each engine is capable of delivering 870 gallons of sewage per minute against a total head of 70 feet. The engines have been designed so that one engine shall be able to deal with the average dry weather flow, two engines working together with the maximum dry weather flow *plus* a small allowance for rainfall, while the third engine is kept in reserve. The party next inspected the new 16-inch cast iron main from the new Law College pumping station to the delivery main from Royapuram pumping station. The erection of new buildings and pumping plant at Royapuram pumping station were next inspected. The new pumping plant consists of two sets of triple expansion Worthington pumping engines with Babcock and Wilcox boilers, each engine being capable of pumping 4,000 gallons of sewage per minute against a head of 50 feet. After this the party were shown the construction of an open channel at the sewage farm, partly on piers and arches, and partly on dwarf walls. This channel supplies sewage to the whole farm through the new irrigation system. The laying down of a system of pipes and channels for the complete irrigation of the sewage farm was also inspected. This consists of a system of underground pipes and surface channels by which sewage can be delivered to every part of the farm. It has now been in operation for two years and by its means the farm is irrigated efficiently. Among the works in progress which were inspected were the sewer laying in streets in Tondiarpet. This has been completed except for a few of the deepest sewers. Of the three pumping stations to deal with the drainage of the whole of Tondiarpet, only the B pumping station was inspected. This is a typical oil-engine and centrifugal pump station. The new plant will consist of three sets of (30 B. H. P.) Campbell oil-engines each driving a 10-inch Gwynne's centrifugal pump. At B pumping station will be raised all the sewage of Tondiarpet which will flow down the 2 feet 10 inch sewer to the bell-mouth chamber where it will join the sewage pumped from Georgetown. The combined sewage will flow down the newly constructed 4 feet 6 inch sewer to the head of the 5 feet 6 inch brick circular sewer,

where a second 4 feet 6 inch sewer will bring in the whole drainage of the western and southern areas of Madras. The 5 feet 6 inch sewer, which is in course of construction, will lead to the farm pumping station. Thus the whole sewage from the three divisions in Madras will flow to the sewage farm pumping station through the 5 feet 6 inch sewer. At the farm pumping station the sinking of a double rectangular silt and screening pit is in progress. Here all the sewage of Madras will be raised into the head of the open channel whence it will be distributed over the sewage farm.

FORENOON'S PROCEEDINGS.

The Conference reopened at 11-30 A.M. in the Council Chamber. Among the visitors was the Hon'ble Sir J. N. Atkinson.

Section A—Medical—met in the Legislative Council Chamber, while Section B—Engineering—sat in the new Executive Council Chamber.

SECTION A.

TRAVELLING DISPENSARIES.

Travelling dispensaries in the United Provinces.

In Section A—Medical—the first paper taken up for discussion was the one on "Travelling dispensaries in the United Provinces" (Volume III) by Captain H. Ross, Chief Plague Officer, United Provinces. The following is a summary of the paper:—

Four experimental travelling dispensaries to be placed in four districts were started in 1910. These although treating various diseases were intended chiefly for the distribution of quinine and treatment of malaria and were therefore only sanctioned for a period of six months—July to December—the worst malarial season. Owing to their great success 32 plague and 11 malaria travelling dispensaries were sanctioned in 1911, and these numbers have since been increased to 42 and 15 respectively. Travelling dispensaries are now working in 33 districts throughout the United Provinces. All the plague travelling dispensaries are allocated to five circles comprising 20 districts, and the 13 malaria travelling dispensaries are apportioned to 13 districts. All are under the general supervision of the Chief Plague Officer working under the orders of the Inspector-General of Civil Hospitals. All travelling dispensaries are under the direct supervision of Indian Medical Service officers, those dealing with plague being collected into circles each supervised by a special duty Indian Medical Service officer, all others being under the supervision of civil surgeons. Each travelling dispensary is in charge of a sub-assistant surgeon who receives orders direct from his supervising officer. One such dispensary costs about Rs. 2,100 per annum (without quinine). All expenditure on plague travelling dispensaries is met from the annual provincial plague budget; the cost of upkeep of the malarial travelling dispensaries is debited to a special varying grant sanctioned for the purpose annually by the local Government. Certain additional travelling dispensaries are now being run from funds specially voted by district boards. The dry drug system is used throughout principally in the form of tablets, pills and ointments. A special type of box and haversack is supplied, and the whole equipment has been worked out with a view to lightness, compactness, and facility of transport, all of which are most essential. The whole equipment can easily be carried on the heads of a few coolies. Travelling dispensaries are most valuable in dealing with cholera and malaria, as they are readily moved to an epidemic area, and they possess a wide educational influence owing to the dissemination of literature, etc. They are universally popular and are very valuable in encouraging the early reporting of epidemic disease and they give promise of a wide extension both in major and minor surgical operations.

Captain Ross, in introducing his paper emphasised the importance of supervision by medical officers. There were 57 dispensaries in 33 districts, and the cost was comparatively small. Facilities of transport were absolutely essential. The output was simple, for example, the medicine box cost only Rs. 4-8-0 and was quite effective. The supply of drugs given out was limited. Pills, tablets and ointments were supplied in sufficient quantities for six weeks or two months. The dry drug system was used, and only 25 kinds of drugs were allowed. The

cost was less than Rs. 2,100 per annum per dispensary. If bazaar drugs were introduced in place of English drugs the cost would be reduced. The dispensaries were becoming more and more popular. Plague inoculation was also popularized through these dispensaries, even at the most unlikely seasons of the year. In these dispensaries, only urgent major operations were performed and patients were always advised to go to headquarters for those operations. Several District Boards had come forward to finance these dispensaries and civil surgeons were universally in their favour.

Anti-malarial measures—Itinerating dispensaries.

Surgeon-General Bannerman then read the following paper on "Anti-malarial measures—Itinerating dispensaries" (Volume III).

"This measure, for the prevention of malaria has been tried in the Gōdāvari district of the Madras Presidency for the past two years with, I fear, but a scant measure of success. The operations were confined to two portions of the Chodavaram division of the Gōdāvari district, which were mapped out and systematically visited by two sub-assistant surgeons each working independently with a travelling dispensary. The villages in each portion were to be visited every two months, those suffering from fever to be treated with quinine, and enough of the drug left behind for prophylactic use during the absence of the dispensary. The work resolved itself into the administration of quinine, and the putting forward of recommendations for the filling in of hollows. No attempt was made to explain to the people in a simple and interesting manner the cause of malaria, nor was instruction in its prevention given. Probably the sub-assistant surgeons were not in a position to do this, for they were not provided with apparatus for demonstration nor with diagrams or lanterns and slides for this purpose. It is clear that they did not appreciate the matter of prevention themselves, for they both became so ill that the tours, for this reason, ended on 31st December 1910, having lasted only four months instead of six, as originally planned. The District Medical and Sanitary Officer under whom the work was carried out reports that the quinine was mainly appreciated by plains dwellers temporarily residing in the hill tracts, rather than by the hill people for whom it was intended. It was likewise found that quinine left behind in villages was not much used by the people when free of fever, and in some instances was thrown away after the departure of the dispensary. The District Medical and Sanitary Officer believes that the small success of the trial was due to the ill-health of the sub-assistant surgeons, to the difficulty of travelling in a wild and hilly country devoid of roads, and to the smallness of the villages. The results obtained were very disappointing. The number of villages visited during the four months was 141, and the splenic index reported was 39·2 per cent. Yet the numbers allowing themselves to be treated were disappointingly small. The actual totals were—470 treated for malaria, 728 treated for spleen, 2,226 treated prophylactically. It therefore appears that in each village only 3·3 persons were treated for malaria; 5·1 persons were treated for spleen; 15·7 were treated prophylactically. In the following year the dispensaries worked in the same part of the district from September 1911 to the end of January 1912. The total number of villages visited was 136 and the number of patients treated for fever 107. Those treated prophylactically numbered 5,767. It will be seen that the results are only slightly better than in the previous year. The number of fever cases treated in each village averaged less than one person (actual 0·78) and is even fewer than in the previous year. The number of persons treated prophylactically is however higher, being 42·4 for each village. This seems a disappointing result of the work of two men for five months; working out, as it does at about twenty-three cases each a day, taking twenty-five working days in the month. With this practical experience before us, the Sanitary Commissioner and I have drawn up a scheme on the following lines and submitted it to Government for sanction, and we should be obliged if delegates who have had greater experience than ourselves would discuss this important matter with a view to perfect the design. We believe that these travelling dispensaries should be much more than mere drug dispensing concerns. They ought to be used to diffuse knowledge among the villagers with regard to the cause and prevention of malaria. For this purpose the sub-assistant surgeons appointed should be carefully trained and selected. They should go through a course of instruction,

under the malaria expert, in the life history of the mosquito and the malaria parasite. They should be taught to distinguish between the malaria-bearing and the harmless mosquitos. They should be drilled in the life history of the malaria parasite in man and in the mosquito. They should be shown these things and made to believe in them, so that they may become enthusiastic in convincing others. They should likewise receive instruction in taking the splenic index, and in making a census of fever cases. In the matter of prevention they should be taught the proper use of the mosquito net, and how to give quinine in the best manner. They must be given a lantern and slides, and attractive diagrams, and instructed in the art of the popular lecturer. This would enable them to give lantern lectures in the evening at the village. Lastly they should be provided with nets and other apparatus for catching larvæ to enable them to demonstrate to the villagers that mosquitoes really do originate from the "wrigglers" in the pools. This latter plan was tried with considerable success on the lands of the Improvement Trust in Bombay by Mr. Orr, the Chairman of that body."

Surgeon-General Bannermann congratulated Captain Ross on his success in the United Provinces. In Madras the success was less, and he thought it was due to the improper selection of medical officers and their training. They had devised in Madras a new course of instruction for these medical officers as pointed out by Captain Ross in his paper.

Captain Ross, in reply, said that the dispensaries in the United Provinces totally differed from those in the Madras Presidency. In the United Provinces there was no prophylactic treatment of malaria in these dispensaries. If a malaria epidemic occurred, the District Boards would be indented on for the supply of quinine to the dispensaries. Referring to instruction he said that it would not be possible to educate the villager to the extent proposed. In the United Provinces, however, thousands of leaflets—illustrated and otherwise—were being distributed on plague, cholera, small-pox, malaria, consumption, etc. In Madras, he thought that no stay was made in villages, but the United Provinces dispensaries stayed a week or a month or more in large villages as necessity occurred.

Mr. Moti Lal Ghose said that he was of opinion that permanent dispensaries would be better than travelling dispensaries, as they instilled more confidence among the people. He doubted if the medical men had themselves discovered the causes of, and treatment for, the prevention of malaria. The best course to be adopted was to enable the villagers to remove obstructive drainage which he thought was one of the causes of malaria, and a certain amount of discretion must be used by medical men in administering quinine.

Rai Bahadur Kailas Chandra Bose also congratulated Captain Ross and said that he wished to be enlightened as to the after-treatment of cataract cases. He doubted whether junior subordinate doctors could be employed for plague inoculation.

Captain Ross replied that younger men who were more energetic were the most desirable persons to be employed on such duties. The only things required were supervision and training, which were always given. Plague inoculations were very easy and could be done even by sub-assistant surgeons. Cataract operations were, save in exceptional cases, performed by Indian Medical Service officers. The after-treatment was very carefully supervised.

Dr. Bentley said that in Bengal the men who were concerned with vital statistics were supplied with drugs. In Bengal it was difficult for travelling dispensaries to work throughout the year. Villagers were willing to supply temporary sheds which could be used as dispensaries.

Captain Ross replied that the travelling dispensaries only moved from one large village to another. The cost of temporary sheds would be prohibitive. In the United Provinces they were about to experiment with travelling caravans with bullocks. The dispensaries moved only short distances at a time.

Mr. Orr said that he had experience of a travelling dispensary in a hilly district in Ahmednagar which he had initiated. A hospital assistant thoroughly qualified by sympathy and energy was sent there and a fixed programme was

mapped out. The man visited market towns on fixed days in each week, and the villagers knew where to find him. This system was very popular.

Colonel Browning Smith said that travelling dispensaries were introduced in the Punjab in 1908. They were secondary, of course, to plague. He quite agreed as regards the necessity for constant supervision by qualified medical officers. The system in the Punjab differs from that of the United Provinces in that the dispensaries were in the charge of Indian Medical Service officers and assistant surgeons and not of sub-assistant surgeons. Inoculation was not as a rule, entrusted to sub-assistant surgeons.

Major Clemesha said that there were 25 travelling dispensaries in Bengal and they were mainly for the dissemination of knowledge of the advantages of quinine and its distribution. They had another supply of trained assistant surgeons who were employed for teaching purposes. There were in Bengal two different sections, *viz.*, treatment and teaching.

Rai Bahadur Ganga Prasad Varma said that the dispensaries in the United Provinces were extremely popular and more were required.

PLAGUE.

The Annual reappearance of plague.

Lieutenant-Colonel Browning Smith then introduced his paper (Volume III) on the above subject, of which the following is a summary :—

An enquiry into the facts connected with the reappearance of plague in the Punjab in the autumn of 1911 and in previous years, showed that the annual epidemic has its principal origins, not so much in those few places where actual signs of plague have been observed to persist throughout the summer, but in places where plague reappears without any fresh importation to account for it, after a period of apparent freedom during which no rat mortality or human plague has been observed. Out of the total number of 56 epidemics which occurred between 1st August and 15th December 1911, *i.e.*, at the beginning of the plague season, in three only was infection evident throughout the summer, and these only led to four other epidemics, a total of seven, whereas plague re-appeared in 38 places with no evidence of importation to account for it, and from these spread to eleven others, a total of 49. In dealing practically with plague this fact is of enormous importance, for in the suppression or mitigation of the original outbreaks lies the best hope of diminishing the extent of the annual epidemic but these re-appearances greatly increase the difficulty of the problem.

Colonel Browning Smith in introducing the paper said :—" This question of the reappearance of plague at the beginning of the plague active season appears to me to be one of extreme importance, because our only hope of materially influencing the annual visitation lies in an attack on these beginnings. Plague is reduced to very small proportions in the hot weather in the Punjab and by the end of August little if any is reported ; it then begins to increase and continues to do so till the beginning of May usually, perhaps to 30, 40, or 60,000 deaths a week and then rapidly declines; this decline period varies from year to year, but for any year is definitely fixed, so that the length of the plague active season is also of definite length and consequently if we can keep plague back at the beginning by a week only, we shorten the plague season by a week, and save a week's mortality at the height of the epidemic. It was at one time naturally thought that the origins of the annual epidemic lay in those places where signs of infection continued through the hot weather; if this were so there would, in my opinion, be no plague problem for these places are so few that considering the stakes at issue any government would legitimately apply such compulsory measures to these few localities that spread of the disease from them would be entirely prevented. The problem, however, was found to have no such simple solution. It was found that plague reappeared in the autumn in many places after a period, more or less prolonged, during which no signs of plague were apparent. It is this fact that has made the plague problem so difficult to solve.

The object of my paper is to demonstrate this fact by the inquiry into all the infections that occurred in the Punjab from 1st August to 15th December last.

It will be seen in Map A, that signs of plague persisted in only three places during the summer and that although a large number of cases were exported from one of these only four secondary epidemics resulted from importation—*seven epidemics in all*. Whereas in Map B, plague reappeared with no discoverable source of importation to account for it in 38 places, infection spreading from these to 11 others, 49 in all. I have no time to go into the reasons which lead me to think that the reappearance of plague in these places was not due to fresh importation and I must leave those who are interested in the matter to refer to the paper but one point I particularly want to make clear—if you will kindly refer to Map C for a moment—importation is just as great a factor now in the spread of plague as it was when it first spread over India *but* importation presupposes an infected spot from which plague is exported—if importation could be prevented the annual visitation would be greatly reduced, if reappearance could be prevented it would be practically abolished."

In reply to Major Liston, he admitted that he could not prove that plague could lie dormant for a long period, say, a year without reappearing.

The importance of the persistence of infection in certain villages during the off-plague season.

Major Liston introduced a paper on the above subject (Volume III)—prepared by Captain Kunhardt, member of the Plague Research Committee. The following is a summary of the paper:—

In this paper figures extracted from the Plague Progress Reports of the Government of Bombay, as far as they concern the Poona district, are analysed to ascertain to what extent plague infection manages to survive the adverse conditions prevailing in the months of April, May and June in the villages of that district. The author draws attention to the several fallacies inseparable from the collection of vital statistics in the rural areas of this country, but maintains that in spite of these fallacies a study of such figures yields lessons of importance. The figures show that in the Poona district (1) there is no portion of the district which can be considered as an endemic centre of plague, nor are the annual epidemics in the district entirely dependent upon the importation of infection from places outside the district; (2) plague may persist through the off-season in any village; infection late in the plague season is favourable to such persistence; (3) the number of villages in which infection persists is very small, only a fraction of the number that are infected during the course of epidemics of average severity. Similar figures for the districts of Sholapur and Ahmednagar are also examined. In both these districts the complete failure of plague infection to survive the off-season of 1900 was followed by a more or less prolonged immunity of these districts from plague. The practical lesson that is to be drawn from these conclusions is that were it possible to detect the few villages that are carrying infection over any non-epidemic season, much might then be done to prevent the subsequent visitation of the disease.

Defective registration of plague deaths.

Major Liston then introduced a paper (Volume III) prepared by Dr. Turkhud on the "Defective registration of plague deaths." The summary of the paper is as follows:—

This paper is based on the results of certain plague investigations carried on by the writer in the Satara district of the Bombay Presidency from 1908 to 1910. His inquiry showed that the first plague deaths during an epidemic as registered in the village records are not actually the first deaths from plague; that infection is present for some time previous; and that the early plague deaths are registered as due to "fever," "diarrhœa," or other causes. Examples are given in support of this, and the writer concludes that attempts made to trace the origin of epidemics from the first plague cases as recorded in the village registers would obviously lead to erroneous conclusions. For verifying therefore the cause of every death which

occurred in villages under his observation, the writer had to employ a special staff. The lines on which this agency worked are described. Fifty-four villages were kept under special observation for a period of two years, and it was found that in every instance where a village became infected the source of infection could be traced to another infected village. No outbreak could be attributed to the "recrudescence" of plague.

Lieutenant-Colonel Browning Smith said that he quite agreed with Dr. Turkhud that there was considerable error in the official registration of plague deaths and although the official figures fairly accurately indicated the amount of plague, conclusions drawn from them in the quiescent season could have no value. In the investigations in the Punjab, these figures are carefully enquired into and corrected by the expert plague medical staff.

A simple method of rat destruction.

Lieutenant-Colonel Browning Smith then described and exhibited (Volume III) a cheap apparatus made of tin for blowing the fumes of burning sulphur or *bhoosa* directly into rat holes and destroying the rats therein, and said that the apparatus would be useful for houses and fields. One defect, however, was that house-owners had to clear out their property before employing this apparatus.

Major Williams said they had a similar tin apparatus in Burma which had been employed by Captain Brayne. He believed in the destruction and prevention of rats. Drains and houses had however to be cleared of these pests, and their clearance often caused great inconvenience to the people Measures which caused very real inconvenience had been stopped by the Government of Burma.

Captain White said a sharp line of demarcation had to be drawn between imported plague cases and imported infection. With reference to Lieutenant-Colonel Browning Smith's paper, he thought that recrudescence of plague was accounted for by acute epidemic plague among rats, without any communication to human beings. One was always meeting cases where imported cases were going on without spreading infection. It was extremely difficult for a purely human agency to carry plague, but, when migrating, people carried their cattle and belongings with them.

Major Clemesha thought it was impossible to explain outbreaks of plague on the theory of importation only. Those who held to the theory of recrudescence of plague had to prove that the plague virus was kept alive for long periods. He asked whether Captain White thought that rat plague went on during the non-epidemic season.

Captain White could see nothing surprising if that were the case.

Captain H. Ross said that in the eastern districts of the United Provinces many villages were plague-infected month by month. He thought that rat-destruction on a large scale was impracticable, and he desired to have the opinion of Lieutenant-Colonel Browning Smith as to what steps should be taken in the succeeding season in the case of a very large number of plague-infected villages in April and May.

Lieutenant-Colonel Browning Smith said that he could not answer the question without the exact figures, but he said he would recommend diligent rat destruction, before the next plague season took place, in those places infected late in the season.

The grain trade as a factor in the dissemination of plague.

A paper (Volume III) dealing with the above subject, prepared by Captain Norman White, was then introduced by him.

This paper deals with the importance of grain as a vehicle for the spread of plague infection in India. After referring to the neglect that grain and the grain trade has received at the hands of sanitarians in India and the causes that have been responsible for this neglect, Captain White draws attention to

the frequency with which the first importation of plague infection into various parts of the country was traced to grain. Bombay, Hyderabad (Deccan), Salem, Palghat, the Dutch Indies, the Ballia and Benares districts of the United Provinces are cited as illustrative instances. It is pointed out that in the western half of the United Provinces where plague survives the non-epidemic season less readily than it does in the eastern half, there is a close parallelism between the imports of grain in a representative year into each trade block, and the amount of plague from which such areas have suffered in the past. The inquiry of the Plague Research Commission into the causes of the immunity from plague of the Bundelkhand districts of the United Provinces is next referred to. It is pointed out that the Banda district appears to possess all the conditions which are at present considered as essential to the presence and spread of plague in an acute form. and yet has remained free from the disease. No anti-plague measures have been taken, and the writer states his belief that the cause of this immunity depends chiefly on the district's independence of grain imported from plague-infected areas. Attention is next called to the influence of grain stores and markets on the persistence of plague infection. The plague history of Cawnpore, which has presented several unusual features, is connected with the importance of that city as a trade centre. Jhansi's plague history is also brought forward in support of the writer's thesis. The remainder of the paper deals chiefly with methods of storage of grain in vogue in the United Provinces and concludes with the opinion that grain far exceeds in importance all other vehicles for the spread of plague infection in India. Preventive measures are suggested on these lines.

In introducing his paper Captain White pointed out the relation between the severity of plague in some districts of the United Provinces and their imports of grain. He particularly instanced Banda, which had remained practically plague free, though with at one time 50,000 refugees from Mirzapur and other plague-infected districts. Banda imported hardly any grain. This instanced how rare was the importation of infection through human agency.

Plague in the Madras Presidency.

Major Liston read a paper (Volume III) prepared by Captain Taylor on "Plague in the Madras Presidency." The following is a summary of the paper :—

The facts as to the local distribution of plague in the Madras Presidency are given along with their relation to climatic and physical conditions and to rat-flea prevalence. It is shown that except on the west coast, only the higher lying parts of the Presidency have suffered in any degree from plague and that the disease has practically been confined to elevations of over 1,000 feet, the total deaths below this level since the first outbreak of plague till 1911 being only about 200. The high-lying parts of the Presidency (*e.g.*, Hosur taluk) which forms part of the Mysore plateau at an elevation of about 3,000 feet, are shown to be practically endemic centres of plague, while the areas lying between 1,000 and 3,000 feet suffer less regularly, but occasionally have severe outbreaks in the larger municipalities, while the rural plague is always very slight. Bellary district is the exception to this and has suffered severely both in towns and rural areas, the amount of plague in different years varying very much, plague being very bad in some years and almost absent in others. It is also shown that the highest lying areas in which plague is endemic are the coolest and that the rat-flea prevalence in these areas is higher than in any other part of the presidency, while the long low-lying East Coast area which forms the greatest part of the presidency has no proper "cold weather" except in the extreme north and that the flea prevalence is lowest here—this area having almost entirely escaped plague. The areas intermediate in elevation also occupy an intermediate position with regard to temperature and flea prevalence, the cold weather being short and mild and the highest rise of flea prevalence being of limited duration. The greater part of this area has only been occasionally infected and mortality has only reached a considerable height in occasional outbreaks in large towns. It thus appears that there is a fair correlation between cold weather conditions, the number of fleas found on rats and the presence of plague, the

proximity of a place to infected areas, as in the case of the Bellary district acts as a modifying factor because of the increased facilities for importation of infection.

Captain White thought Captain Taylor's position indefensible and said climatic conditions were insufficient to explain the immunity of Madras from plague. Temperature alone and without regard to other circumstances could not afford sufficient explanation. Bellary accounted for half of the deaths of the presidency. This Captain Taylor attributed to its proximity to plague-infected areas in Bombay. Why should not the same argument apply to the districts surrounding the Mysore plateau where plague was endemic? He disliked the term "favourable conditions" as applied to plague, and said that there was in general a danger of considering a place hitherto free from plague as containing conditions which made plague impossible.

Fleas infesting the Mus Rattus.

Captain H. Ross then read "A note on the fleas infesting the Mus Rattus in Nani Tal and Mussoorie" (Volume III).

Plague preventive measures.

Captain W. C. Ross then read a short paper (Volume III) on "Prevention of plague." He discussed the value of disinfection by pulicidal or combined pulicidal and bactericidal disinfectants, rat destruction and inoculation. He said that in England immunity was due to the general separation of rats and men. The policy in India for plague prevention should be to imitate English conditions as far as possible. He said that in the matter of habit there were also differences in which the chief point seemed to be that the rat was not so domestic an animal in England as it was in India—probably because of the difference in the construction of houses and drains, which had driven him into a different mode of life.

Major Liston then read Captain Stevenson's paper on "The absence of a 'Negative phase' after inoculation with plague prophylactic" and also his own paper on "Plague preventive measures" (Volume III).

The following is a summary of Captain Stevenson's paper:—

This paper discusses the question of the existence of a "negative phase" or period of increased susceptibility to plague infection after inoculation with plague vaccine. The practical importance of this subject is pointed out. On the answer depends the advisability of inoculating persons living in plague-infected houses. This was one of the problems which was left unanswered by the International Plague Conference at Mukden in 1911. The opinion of the delegates was divided, but it was obvious that further research was necessary. It is pointed out in this paper that the deductions drawn from the mass of statistics of inoculation work throughout India point to the absence of any such period of hyper-susceptibility to infection after inoculation and two well-controlled experiments on large nmubers of rats are detailed which prove that in the case of these animals there is a complete absence of a "negative phase."

The following is a summary of Major Liston's paper:—

He compared plague to such diseases as hydrophobia, glanders and anthrax which are communicated to man generally through his association with certain animals; dogs in the case of hydrophobia, horses in the case of glanders and horned cattle in the case of anthrax, while of course plague is conveyed to man through the rat. Experience has shown that the best way to prevent the spread of these diseases to man is to take measures against the animals which in each case convey infection to him. Laws exist to enable the responsible authorities to take action on these lines in the case of hydrophobia, glanders and anthrax, but the law gives no assistance in the case of plague. Valuable animals can be seized and destroyed without compensation so far as the former diseases are concerned, but rats which spread plague, which are worthless and even destructive creatures, can be harboured and nourished with impunity, the interests, and even the prejudices of individuals are considered to the detriment of the majority. He thought that the time had arrived when those responsible for the public health should be aided by the force of the law to compel persons either to

destroy rats on their premises or make their buildings rat-proof. He said that the conditions which encourage the association of men with rats favour the spread of plague. Rats for their multiplication require food, shelter and freedom from molestation and they found all these favourable conditions in Indian dwellings. The careless habits of Indians in regard to the disposal of refuse and the absence of satisfactory systems of scavenging in India fostered plague. The housing of cattle and other domestic animals in dwellings must be prohibited if plague is to be prevented. The proper storage of grain and other food in retail shops must be insisted upon, while grain in bulk must be kept in rat-proof godowns.

He drew attention to Mr. Orr's paper on "Light and air in dwellings in Bombay"; he endorsed and emphasized Mr. Orr's opinions and pointed out that rats select dark places to live in so that the measures suggested by Mr. Orr to increase the amount of light and air entering the dwellings of the poor were as applicable to the prevention of plague as to the prevention of tuberculosis. Model building bye-laws are very necessary, but they can only bring about a change in defective sanitary conditions very slowly so that some measure must be enforced which can be applied at once, not only to prevent future mistakes but to rectify those already made.

Instruction as to the manner in which disease is spread is an essential part of any campaign against plague. It is necessary to instil into the minds of Indians that horror and repulsion for rats which is a natural attribute of the European. A complete sanitary organisation with ramifications in every village, consisting of a permanent staff known to the people and supervised by the district officers both civil and medical, would be the best means of instructing the people in the prevention of the spread of disease, but the cost of such a scheme, which for the Bombay presidency alone would amount to about ten lakhs of rupees annual recrurring expenditure, would be financially impracticable in the present circumstances of the country. Major Liston suggested, however, that by making some person in each presidency wholly responsible for the instruction of the people in public health matters and by providing him with adequate funds and a suitable staff such an officer could, by co-operating with existing departments of Government and with civil organizations and institutions, communicate information to the literate in the hope that it might in the end reach the large mass of illiterate persons in India. He had enlarged on what he called permanent measures for the prevention of plague. These measures were specially applicable to towns and he had little time to speak of the well-known temporary anti-plague measures of rat destruction, inoculation and evacuation, further than to say that inoculation was more and more recognised as the cheapest and best method of attacking plague in villages when it had developed into an epidemic. He said that rats were harmless, so far as plague was concerned, so long as they were not infected and he drew attention to the papers by Captain Kunhardt and Dr. Turkhud on the importance of the persistence of infection in a limited number of villages during the quiescent plague season and to the momentous consequences which followed on the importation of infection from these villages to others in the district in the early part of the epidemic season. It was very desirable he said that some scheme should be devised to recognise those villages which carry over infection from one epidemic season to another and that the energies of the preventive staff should be concentrated on them during the quiescent season, when the forces of nature of themselves tended to check epidemics of plague, utilizing well organised schemes of rat destruction, evacuation and inoculation.

Mr. Motilal Ghose drew attention to the slaughter of rats referred to in Captain W. C. Ross's paper, in which Captain Ross admitted that the destruction of rats had little ultimate effect. He agreed with that admission and thought that rat brigades were of little use.

Summary of discussion.

Surgeon-General Sir Pardey Lukis, in summarising the discussion on the papers relating to plague, said:—

"I think the useful conclusions that have been arrived at in the course of today's discussion may be summarised as follows:—

The first point, without going into the question of chronic rat plague which is after all a matter more of scientific importance than of practical utility, is that the question of late infection of villages, which will afterwards act as bridges and carry over the infection to the following year, is one of the most important subjects for our consideration. The difficulty is that it is only a small proportion of these villages which actually act as bridges and start epidemics in the following year. That, I think, is admitted by all those who have spoken to-day. The point of difference is that one set of observers hold that there are no definite signs by which we can judge as to which of these villages will act as bridges in this way, and which will not. Other observers, however, hold that this is not the case; that, as a rule, there are such definite signs, and that in cases where these signs are said not to exist this is due either to defective registration, to wilful concealment or to insufficient inquiry. Leaving these doubtful points on one side, I think we must admit that the practical conclusion at which we have arrived is that every effort should be made during the quiescent period to deal with the villages that are carrying over the infection and that vigorous treatment is necessary during the non-plague period.

The next point that arises is that which has been brought up by Captain Taylor as regards the immunity of Madras. He holds that this is due chiefly to climatic conditions. Captain White controverts his deductions. It seems to me that here is a case in which further investigation is necessary. I believe that experiments and inquiries are being made by the Plague Commission on the influence of climatic conditions and I suggest that the Conference should not commit themselves to any opinion whatever as to the causation of plague in the Madras presidency.

Thirdly, as regards the influence of grain, Captain White has clearly shown that there is a close correlation in a representative year between the imports of grain into each trade block and the amount of plague from which such areas have suffered in the past, and he also shows that grain stores and grain markets have a large influence on the persistence of plague-infection in a given locality, and he further advocates preventive measures on these lines. This is a point which will require very careful consideration, because it is a measure which is likely to involve considerable expense if carried out.

Another important point which comes out is in the paper on plague inoculation. It has been clearly shown there is an absence of so-called "negative phase" and that plague inoculation is not only harmless, but that it is actually beneficial to people who are in close contact with plague conditions.

Lastly, we come to Major Liston's admirable paper in which he deals with the question of plague as disease produced by an animal and advocates that measures be taken against the rat in the same way as they are taken against the dog in the case of rabies. I don't think we can get away from the fact that these measures are necessary, but still it is perfectly possible to take measures against the rat without committing wholesale destruction of these animals. Presuming that the rat is infected, you can deal with him (1) by cutting off his food supplies both by house tidiness, by improvement in scavenging, and prohibition of the housing of animals in the vicinity of human dwellings, (2) by abolishing dark places and providing light and air in houses, and (3) by instructing the public and making them realise that, although the rat is a perfectly useful animal in his own place, that that place is not the human habitation.

Finally, as Major Liston points out, the rat is only dangerous to man when it is infected by plague, and therefore our chief object should be to prevent the rat from becoming infected, and in this connection it is desirable that an attempt should be made during the quiescent period to ascertain those villages which are likely to carry over the disease into the following year and then to deal with them in a summary manner."

SECTION B.

SANITARY ENGINEERING.

The members of Section B met in the Library room of the new Legislative Council Chamber, at 11-30 A.M., under the presidency of Mr. W. Hutton. Fifteen delegates attended the meeting. The first item for consideration was a paper read by Mr. Montgomery, Sanitary Engineer to the Punjab Government, on "The Simla hydro-electric scheme" (Volume IV).

The Simla hydro-electric scheme.

The following is a summary of the paper :—

The Simla hydro-electric scheme is being installed for the purpose of supplying light and energy to Simla and also to supply energy for pumping water to augment the present supply. Power is being obtained from the "Nauti" Khud, a tributary of the Sutlej, and a minimum flow of 28 cusecs is obtainable from it. The water thus obtained is led down an open flume which runs along the hillside to a large storage reservoir which holds 8 hours' full working supply, and thence passes on to the power house which is situated 540 feet below. The power house, which is constructed in two halves, will contain 3 Pelton wheels which are each directly coupled to an alternator of 250 kilowatt capacity. At present only three sets are being installed, but the power house will eventually contain six complete sets. The power is generated at 2,200 volts and is then stepped up through transformers to 15,000 volts for transmission to Simla. The current is transmitted to Simla along No. 5 S. W. G. copper wire lines where spans between the structures are under 2,500 feet, but where this span is exceeded the lines are composed of No. 3 S. W. G. Silicon bronze wires. Two transmission lines leave the power house—one to Simla direct, and one to the pumping station at Chair. The former is 9 miles long and the latter is 12 miles long. Also Simla is connected with the Chair pumping station by a line 7½ miles long. The current which reaches Simla at a voltage of 15,000 volts is stepped down in the main Simla sub-station to 2,300 volts and is again stepped down in the small sub-stations to 220 volts for street and house lighting. Inter-connected with the scheme is the water-works extension. The water-supply of Simla is in immediate need of being increased, and advantage has been taken of electric energy being available to transmit current to Chair where a copious supply of water is available about 13 miles from Simla and 3,000 feet below Fagu village on the Hindustan-Tibet road. The pumping station at Chair will be equipped with two induction motor driven slow speed plunger pumps, which will raise the water at the rate of 280 gallons per minute in one lift to a small reservoir, 2,800 feet above, whence the water will gravitate to Simla for use. The water of the nullahs tapped is of great purity, but as an additional safe-guard it will be passed through "Jewell" gravity filters before passing to Simla. The existing pumping station of the Simla water-supply will also be electrified which will result in a great saving of fuel. The cost of the hydro-electric portion of the work is Rs. 13,20,264 and the water-works extension is to cost Rs. 4,70,388.

Sanitary problems in Madras.

The next paper dealt with the "Sanitary problems in Madras" (Volume IV) and was contributed by Mr. Hutton, Sanitary Engineer to the Madras Government. In the course of his paper, he referred to the following points :—

"The advance of sanitation in the Madras presidency is necessarily slow owing to many causes, the chief of which are the reluctance of the responsible authorities to provide sufficient funds and the backward condition of the people in understanding sanitary methods. Despite these adverse conditions we have accomplished in the presidency a considerable number of works which admittedly have improved the health of the communities affected thereby. I propose in

this paper to refer generally to the different classes of works carried out, mentioning the particular difficulties encountered by us with the object of obtaining the views of delegates thereon. It may be advisable for me to state here that the works referred to in the paper are more particularly those intended for towns and villages in *mofussil* areas. Of urban water-supplies we have in use 19, and 6 are under construction. The schemes for water-supply projects of late years have been drawn up on the basis of the probable population thirty years hence. This probable population has been obtained from a population curve or diagram which has been prepared from the results of previous decennial censuses. As a rule, this gives the probable population at about 30 per cent. increase over the existing population. The rate of supply per head is usually taken at 15 gallons for an ordinary *mofussil* town. It is doubtful whether this amount is sufficient, judging from the complaints received from many towns. These complaints are loudest in connection with street fountains which, although numerous, fail to satisfy the people. We must not however lose sight of the fact that during the times of the maximum demand at street fountains the numerous house connections are also being used.

Owing to want of sufficient provision in the original District Municipalities Act, powers for regulating consumption of water, waste of water and for fixing water meters were absent, and consequently the amount of water drawn off by house connections in towns increased out of all proportion to the quantity desirable. A new Act has been passed which gives sufficient powers for regulating wastage of water and for installing meters and charging for excess. Attempts in the past have been made to fix the number of taps allowed in a private house in accordance with the rental value of the house and the taxes paid thereon, but practically no serious attempt has been made to fix meters or to make a charge for excess water. Consequently the amount of water wasted is relatively enormous owing to leaky taps and to taps left constantly open. I should prefer to fix a meter on every house connection at the municipal cost and to charge a rent for such meter to the owner or occupier of the house. If water is required for non-domestic purposes, such as ærated waters manufacture or other trade purposes, the water so used should be measured by a special meter and charged at a rate approximately double that of the domestic rate. The introduction of these rules rests with the chairman and municipal councillors, and I regret to say that although their introduction and enforcement would mean a considerable revenue and would solve the problem of how to stop the waste of water, municipal councils hesitate in taking necessary action. The principal sufferers from this inaction of municipal councils are the poorer people who use the public fountains and householders who live at higher elevations. Our experience in Madras has shown that direct pumping into the main at the head-works without the intervention of a service reservoir is bad policy. Owing to the misuse of house connections in the town and the opening and shutting of such and of sluice valves on the distribution mains, it is impossible to maintain the requisite pressure in the main at the head-works pumping station. It is a fact that better results are obtained when the pumping engines pump the water into a service reservoir whence the supply to the town is distributed. When the wastage of water at house connections is stopped, the opening of taps on the connections would still result in such a sudden lowering of pressure in the main in the case of direct pumping, that damage to the pumping engines would result. Experience has shown that a service reservoir is absolutely necessary for the maintenance of a steady pressure, for the protection of the pumping plant and for the provision of a small storage. In the case of such a reservoir a capacity of four hours' supply should suffice. With regard to water taps for street fountains we have favoured for the last twelve years the type known as Tyler's patent automatic self-closing valve with lever handle. This type though expensive is durable. The principal defect is that the automatic self-closing part becomes inoperative after a time. This part consists of a gun metal plug which fits accurately into a casing and is intended to descend by its own weight on to the water orifice, thus closing it. Owing to the accurate fitting necessary for the gun metal plug and the fact that water generally contains a fine sediment, especially after river floods, this plug fails to drop, the mud in the water causing it to stick fast in

its casing. When this occurs the tap becomes an ordinary spring loaded self-closing tap. It is true that the drop plug can be removed and washed but, as a rule, this duty is not performed promptly so that the object of the invention is defeated in actual practice. On the whole, however, these taps have been found the most satisfactory of all the taps tried in the presidency. As the body is made of galvanised cast-iron, few thefts of the taps have occurred. The insanitary state of the village water-supply in the Madras presidency has of late been receiving increased attention.

Now that a considerable number of towns have received protected water-supplies and the benefits derived from such protection in the reduction of cases of cholera and other water-borne diseases have been admitted, it seems necessary to carry this protection further and to improve the sources of water-supply of the villages adjacent to these towns, and also of the more important outlying villages.

A village water-supply is usually derived from an irrigation channel direct, from a pond or tank or from wells. Little can be done in improving the quality of direct supply from an irrigation channel. It can be improved by digging a new tank or improving an old tank fed from the channel. This improvement is gained by storing the water so that the mud in it may settle to the bottom of the tank and the sun's rays may kill the germs contained therein. The next step is to conserve the tank by fencing it and by providing other means of drawing water than the present one of wading into it with the object of filling water-vessels. The best way of drawing water from tanks is the provision of an engine and pump which can be used to fill a small reservoir, either itself provided with taps or supplying a short length of water main in the principal street with suitably placed public taps. For the last six years an installation on this principle has been in use for an outlying part of the town of Salem. At this place there was a large square tank adjoining a main road, and the people were accustomed, after walking on this dusty road, to enter the water of the tank in order to fill water vessels. The contamination of the water by this means was very great. It was accordingly decided to erect an oil-engine and pump, and to pump the water from the tank into a small masonry reservoir by the road-side. This reservoir was provided with 20 taps and the spill water therefrom was conducted into the roadside drain. Entrance to the tank was prevented by a wall surrounding it. The people who had formerly entered the tank were able more easily to draw water from the taps, this saving of labour being much appreciated and the quality of the water-supply was much improved. This improvement in quality was borne out by the results of the cholera visitations. It was observed that the part of the town which used the water from this oil-engine installation did not suffer from cholera, which was prevalent in the remaining parts of the town. The cost of the 7 brake horse power oil-engine and 3-inch centrifugal pump, masonry reservoir with 20 taps and a capacity of 5,775 gallons, surrounding platform and leading off drain, was Rs. 5,000. The annual cost of working, including repairs of plant, was Rs. 1,050. The quantity of water pumped daily was 56,000 gallons and the average lift was 35 feet. Somewhat similar installations, if supplied to suitable village tanks, should give equal sanitary efficiency. In villages which are unable to provide the cost and upkeep charges of a pumping installation, an arrangement of draw-off wells connected to the tank by means of pipes can be substituted.

Village wells are usually deficient in many sanitary requirements. The most important requirement of a well is an impervious platform around the parapet with a surrounding drain and a suitable length of leading off drain, so that no soakage of surface water can occur within 150 feet of the well, if of the usual depth of 20 to 30 feet. The second most important requirement of a well is the drawing off arrangement. This arrangement should, if possible, be either a power-driven or a hand pump. The third requirement is the covering of the well and the cementing of the steining above summer water level. In the case of wells where the draw-off arrangement can only be the usual bucket and pulley, it is considered that the bucket and rope provided should be the property of the village authorities and should not be removed from the well. A further improvement that can be effected in village wells is the provision of a power-driven or a hand pump to fill a reservoir provided with taps and located near the well. Plans showing the improvements described can be shown to delegates.

The natural drainage of a village is a roadside ditch into which the sullage from houses is discharged. As the village increases in size and the nuisance from the roadside ditch becomes more evident, the necessity for developing that ditch into a masonry drain becomes apparent. In constructing open drains we favour oval-shaped masonry drains plastered with cement, as this shape can be more easily cleaned than drains of triangular section made of stone slabs. It is difficult to clean the apex of such drains and the joints in the slabs become impregnated with objectionable matter. As an additional argument in favour of oval-shaped masonry drains it may be said that masonry drains are cheaper to construct than drains of stone slabs, except in the districts where the slabs are locally obtainable. The sizes of oval-shaped drains constructed by us are based on the amount of rainfall falling on their drainage areas, the amount taken being half an inch per hour for places where the annual rainfall is 40 inches and one inch per hour where the rainfall reaches 80 inches.

This type of drainage is necessary for towns, which owing to their flat location cannot be drained by open drains. In such cases sectional pumping is necessary and a good example of this type may be observed in the city of Madras. By the use of closed sewers all the objections stated against open drains are removed. The disadvantages of closed sewers for *mofussil* towns are the deficiency of water-supply for flushing, the difficulty of dealing with the rainfall which falls on roofs and courtyards and which unlike the home country is not distributed over the whole year, and the difficulty of providing satisfactory house connections owing to the peculiar construction of an Indian house and the habits of the people. The deficiency in the piped water-supply of mufassil towns for flushing sewers can be overcome by the provision of flush tanks filled either from existing wells or from new wells sunk near the tanks. Excess rainfall may be kept out of sewers by excluding all rainfall which falls on roads and similar areas and by limiting the amount taken by the house connection, the excess being surplussed into the roadside drain. I prefer to take all silt into the sewers, to give them suitable gradients and to rely on silt clearance and flushing of the sewers themselves. Besides having few or none of the disadvantages of open drains, a pipe sewerage system possesses the distinct advantage of permitting the conversion of all latrines into water carriage latrines, thus getting rid of the objectionable conservancy carts and trenches.

A considerable sum of money is being expended in the Madras presidency in opening up congested areas. The method often adopted of acquiring insanitary houses and forming new roads through congested areas in a town before provision has been made for the dispossessed people, is one which should be condemned. A type design showing the laying out of new house-sites can be shown.

While the grain, condiment and fruit stalls of markets in this presidency are fairly satisfactory, the construction and upkeep of the meat and fish stalls cannot be considered in any other way than very bad. The first essential of a good market, viz., cleanliness, is not aided by the class of people who deal in meat and fish nor by the public opinion of the more respectable classes who usually avoid these sections of a general market. Municipal authorities, probably for similar reasons, are not sufficiently attentive to the cleansing of these meat and fish stalls, and this remark also applies to important cities in India, by being sluiced by a hose before and after the day's operations. The platforms recommended are masonry ones lined with white tiles or wooden frames lined with zinc sheet. In the case of both meat and fish stalls it should be the invariable rule that no storage over night in any lock up place or box in the stall, should be permitted.

A design for a public latrine which can be accepted as really satisfactory in actual practice is one of the most important problems in sanitation. Such a design is only apparently possible where a sewerage system exists or where a system of automatic flushing for the latrine with septic tank and land treatment for the effluent can be arranged. Large sums of money are annually expended in constructing public latrines, but it can be safely stated that excepting the two classes of water carriage latrines referred to above, no European would voluntarily use any of the dry class. The question therefore is what is

the least unsatisfactory of this type, and should any be constructed? Should not all important public latrines in places where no sewerage system exists be constructed of the second type as recommended by Major Clemesha at the first Sanitary Conference in Bombay?

In the home country the success of sanitary methods could not be expected if the co-operation of the people had not been secured, and this has been brought about by the aid of articles in newspapers, lectures and instruction in schools, which have kept pace with or preceded the execution of sanitary schemes.

Simple health lectures should be given in schools in towns to both boys and girls on the necessity for cleanliness in the home and surroundings. These lectures should emphasise the need for pure water and warn against waste, should inculcate protection of food from dust and flies, ventilation of the house, cleanliness of house drains and surroundings, destruction of refuse and cleanliness of clothing and the person. In addition to this, municipal officials should interest themselves in the instruction of householders, especially the women, in similar subjects, this instruction serving a more important object than the prosecution of offenders. As a matter of fact, prosecution of offenders against bye-laws is almost non-existent."

Mr. Belvadi inquired where the money was to come from to fix meters to houses. Putting each meter at the lowest at Rs. 5 the cost would be excessive in the case of a town of 5,000 population.

Mr. Curtis suggested that they might have ½-inch pipes for house connections and meters only for big houses.

Mr. Hutton said that meters would be fixed only where they expected large revenues.

Then ensued a discussion as to the average quantity per head of population per day that would be required for consumption.

Mr. Williams said that in Bengal there were many towns where people got only two gallons per head. A supply of ten gallons was, in his opinion, amply sufficient.

Mr. Montgomery was of opinion that ten gallons per head was a very reasonable supply.

Mr. Madeley inquired why it was that Bombay and Calcutta allowed a supply of 40 and over 40 gallons, respectively, per head. Was it because the demands of civilised society required more water, and in that case was it anticipated that there would be similar demands from other growing towns? In Madras they were going to supply 25 gallons per head, and a number of commissioners were desirous of having a supply up to 50 gallons, as in their opinion that was a necessity for Indians. In regard to meters Rs. 100 was the estimated cost of each meter, and that would be a big item, and would be an extra charge on the cost of water-supply. The proposal of the Corporation was to have two classes of supply. One ordinary, by which every *pucca* built house would have a free tap, and if any one wanted anything better, he would have to pay for metering his supply, and for all water consumed in excess of a fixed free allowance depending on the rental value of the house.

Mr. Belvadi said that the quantity to be allowed per head depended much on the class of population in a town. If there was a large Brahmin class, the quantity must be comparatively larger; 15 gallons per head would have to be the minimum, with a maximum of 50 gallons.

Mr. Pillai said eight or nine gallons were sufficient for actual domestic purposes and five or six gallons for cleaning. The majority of the people did not bathe.

English and Indian sanitary engineering.

The next paper taken up for discussion was "Some differences between English and Indian sanitary engineering practice" by Mr. Williams, Sanitary Engineer, Bengal (Volume IV). The following is a summary of the paper:—

"In his preliminary survey of a problem of urban water-supply, the Sanitary Engineer in India will usually be impressed by several important points. He is

limited in his proposals by the inadequate funds at his disposal; he probably finds the municipality already more or less abundantly supplied from existing sources with water of a very questionable character, most of which would be condemned at sight in an English town or village, and he has to provide for a population apparently to some extent immune by descent from a long line of ancestors (who have consistently drunk water of similar quality) from the worst effects that would be experienced by a pure water drinking community if they were suddenly translated to an Indian village and made to exist on such water as is normally consumed there. Another point to be taken into consideration is the greater potency of the sun's rays in India as a germicidal agency than in more temperate countries. On the other hand, the prevalence of cholera, and the consequently more dangerously polluted condition of most of the natural sources of supply, are factors in the opposite direction. The foregoing consideration will be sufficient to show that an engineer responsible for preparing a water-supply scheme for an ordinary Indian town, will have to depart somewhat widely from the lines on which an European installation would be designed. The first essential will be that the scheme should be a cheap one, otherwise there will be no scheme at all. The source of the supply will frequently be one which could not be considered safe in an European country, the quantity of water given per head will be much less, whilst the greater purifying effect of the sun's rays and the partial immunity of the inhabitants to water-borne diseases may enable a simple form of purification to be considered fairly adequate.

A suitable source of supply for a town of anything up to 12,000 inhabitants in Lower Bengal, is frequently one or more large tanks situated either on the outskirts of the town or, possibly, if a suitable area can be found, in the centre. In districts where there is a sandy or porous sub-soil, wells will probably be indicated as the best source of supply. If there is a permanently flowing river that will naturally be chosen and in places where there is a sandy river bed, dry on the surface in the hot weather, filtration pipe or gallery under the bed is likely to be the most satisfactory arrangement, Artesian and Sub-artesian conditions are not likely to be frequently found within the delta area and the prospects of such wells being found productive in the greater part of the Bengal Province are not very favourable. Some form of purification will nearly always be needed for a distributed water-supply, whether the source of supply is a tank, river or well. Where cheapness is the first consideration my opinion is that provided that an ordinary water can have a settlement and exposure to sunlight of at least 7 days, it will be moderately safe and potable if pumped directly through a mechanical pressure filter. This would obviously not be sufficient in the case of any special form of contamination, such as water impregnated with soluble iron salts or containing excessive vegetable matter. With regard to the works of distribution of water there is not much scope for difference in design from European systems.

In the case of drainage schemes the differences between Indian and European requirements are more marked than in water-works practice. In fact it may be safely said that the complete sewerage system with private connections at all houses is quite unsuitable to Indian towns. Municipal drainage schemes may be divided into four classes. Commencing from the simplest form upwards. These are—(*a*) a simple system of *kutcha* open surface water drains with possibly one or two main drains with masonry inverts; (*b*) a system of masonry open surface water drains; (*c*) a system of masonry open drains with one or two main intercepting sewers and (*d*) a complete sewerage system. It cannot I think be too clearly insisted upon that in India all private house connections and small branch drains should as far as possible be open, whenever excremental matter is not carried by them. In the ordinary Indian towns, even the larger ones, the majority of houses are of the most inferior form of construction, and for such buildings private water closets and closed branch connections are entirely out of place. The combined system of drainage is extremely unsuitable to Indian conditions. With regard to the purification works at the outfalls of sewerage system the main point to be noted is the greater efficiency of the septic tank than in European towns. On the other hand, the work performed by filters where these have been adopted has been rather disappointing.

To enter into all the minor differences between English and Indian practice would require more space than I am justified in occupying. There has been,

I think, some tendency in the past on the part of engineers whose experience has been mainly confined to European systems to suppose that these can be transferred wholesale to Indian towns. Such an idea only leads to unfortunate results. On the other hand, without an intimate knowledge of the methods of sanitation in the more highly civilized countries, no progress is possible. A system of sanitary engineering suitable for India will in time be evolved which will be an imitation of such processes and works as may be suitably accepted, and adaptation of others, and on certain lines strike out in original directions."

Sanitation in India.

Mr. Mandy next introduced his "Note on Sanitation in India" (Volume IV), of which the following is a summary :—

Sanitation is a science but recently introduced into India, and is therefore not in a very advanced state. Some progress has been made with urban sanitation which presents no great difficulty in carrying out, but as it entails a considerable increase in the current rate of taxation in most towns, Government have to recognise that progress must be slow and measured by the strength and character of the public opinion they have to rely on in support of sanitary measures. In India, therefore, as elsewhere, the carrying out of sanitary work is now much more a question of available expenditure than of knowledge. Rural sanitation has made no progress, in fact it barely exists, and is a question of magnitude and difficulty. Therefore, to improve matters, it has been found necessary to introduce sanitary legislation. The passing of sanitary laws, however, and the granting to a certain department the power to enforce such laws, will not ensure good public health unless the public at large supports those laws intelligently.

The majority of municipal boards in India are dependent on the advice of Government officials in sanitary matters, as they have, with a few exceptions, no independent professional agency to assist them in the preparation of sanitary projects. In such cases the projects are prepared by the Sanitary Engineers to the local Governments and, after approval by the Sanitary Boards, submitted to the local Governments for sanction. To make these municipal boards fully acquainted with the facts for which they are responsible and to stimulate them to greater efforts, it is necessary that clear periodical statements of the vital statistics of the locality should be supplied in the fullest details. Programmes of sanitary works should also be prepared under the chief heads of—1. Conservancy, including the removal of refuse ; 2. filling up of insanitary tanks and cesspools ; 3. latrine accommodation and public urinals ; 4. drainage ; 5. water-supply and 6. the improvement of overcrowded areas and of buildings with defective lighting and ventilation. These projects of sanitation should be carefully prepared with reference to local circumstances and the resources of the boards concerned. Tanks and cesspools constitute one of the most serious difficulties to be met with in many cities in India. In many cities it will take years of persistent effort and the expenditure of large capital to fill up these tanks before the population can fully reap the benefit of sanitary works. As regards the cesspool nuisance, the extreme injury which it inflicts on the health of the population and the vital necessity of abating that nuisance are points which should claim more attention than they do at present. The remedies which can alone avail are proper systems of sewerage with effective water-supplies. Wherever such remedies have been applied, enabling the cesspools to be filled up, statistics tend to show that the death-rate has been reduced from 20 to 30 per cent.

A good water-supply is perhaps the most important sanitary agency in India. But if real benefit is to be obtained, the source of supply must be very carefully chosen and special precautions taken to protect it. It should be out of the reach of the people and the water should be conveyed to them in pipes to prevent any possible contamination.

The regulation of buildings in most towns in India is utterly neglected. The chief reason why the death-rate is high in overcrowded localities appears to be that, as a general rule, they are occupied by the poorest classes unable to pay for sanitary arrangements and the difficulty of sewering or access for cleaning purposes in such localities. Except on the upper floors, a large proportion

of rooms are insanitary through various causes, but chiefly through defective lighting or ventilation. The high death-rate and prevalence of epidemic diseases have naturally turned a considerable amount of public attention to the necessity of building regulations and formation of Improvement Trusts, and it is hoped that the power to veto the occupation of all ill-lighted and ill-ventilated buildings and the opening out of crowded areas, will prove an efficient remedy for the existing insanitary state of affairs in nearly every Indian city.

Whenever proper sanitary regulations have been introduced, statistics show that the death-rate has practically been reduced by from 20 to 30 per cent., and as the very important question of sanitation is now receiving increased attention from Government, there is no doubt that the results of improved public health and the advancement of the standard of civilization will amply reward them for the efforts they are making in this direction.

Dust prevention.

Mr. Cox's " Note on dust prevention" (Volume IV) was next taken up for discussion. The following is an extract from Mr. Cox's note :—

Although the question has more recently become merged in the wider and decidedly more difficult question of improved road construction to meet modern traffic conditions, the sanitary advantages of dust prevention measures in urban areas have been clearly recognized for some years. In tropical climates street watering on metal or gravel roads is practically useless. Not only is the benefit transitory, but by assisting disintegration of the surface, the system leads to the production of dust in greater quantities. As an alternative, experimental measures, both preventive and palliative, have been tried for some years in Colombo and they have materialized in improved methods giving appreciable benefit. Of the former class, but designed with the primary object of providing a more resisting road crust, granite sett paving for heavy traffic, and asphalte macadam for light traffic, have proved most satisfactory and there is no question that in this direction lies the true solution of the dust problem. Although ultimate economy combined with dust prevention and other advantages is assured, the high initial cost is a heavy deterrent to the use of these methods of construction and in consequence recourse to cheaper preventive measures and to palliative measure is found necessary. Stone cube paving laid on the Kleinpflaster principle was tried, but not found satisfactory under heavy traffic. Concrete blocks with a broken rubble facing were used for bullock cart tracks ; but are now being replaced by granite setts on concrete. Tar macadam of various kinds was experimented with and is still used, but the Works Engineer reports that with the hard gneiss stone available it is difficult to obtain a conglomeration neither too brittle nor too soft, and it would not appear that the extra cost over ordinary macadam is warranted. It should be noted that with all non-dust-producing surfaces, efficient scavenging is essential, even more so than with ordinary macadam, as the dust brought on to the roads from outside sources is more easily raised by wind and traffic. As palliatives or dust layers, tar, tarco, tarvia, liquid fuel waste, liquid fuel and hydroscopic preparations have been tried. The latter class of preparation appears to be useless and tarvia has no advantage over ordinary tar. Tar and tar compounds applied cold to the swept surface give excellent results. They should perhaps be classed as preventives as they improve the surface, lessen production of dust and prolong the life of the road. Tarco gives better results, corresponding with its higher cost. As a dust layer liquid fuel, and more particularly the waste from liquid fuel tanks, gave unexceptedly successful results. In dry weather one application remains effective for two to five weeks, dependent upon the situation of the road and the nature of the traffic. No additional watering is necessary and the dust is completely laid even under fast motor traffic. In wet weather the result is not so agreeable.

Mr. Madeley pointed out that tarring roads by means of a spray would prolong the life of the road and was very cheap and had proved successful.

Another paper on the same subject by Mr. Richards was taken as read (Volume IV).

Models of sanitary works.

The Engineering delegates next inspected certain models of sanitary works kept on view there by Mr. Lacey, Major Forbes-Knapton and Mr. Pillai.

Mr. Lacey had on view some models of sanitary works in Madras, among which were a model of a type of house suitable for villages and small towns, where there is no sewered system. In the type plan for the extension of house-sites for villages the front main roads are 40 feet wide and are provided with drains for carrying storm water, the back or conservancy lanes are 10 feet wide and are provided with masonry drains for conveying house sullage. Night-soil and refuse are removed by conservancy carts working along these lanes. Then a washing platform (shown in the backyard) is an adjunct to all Indian houses here and takes the place of a bath. The water from this platform with the house sullage passes into the masonry drain running on either side of the conservancy lane. The night-soil is collected in tins or pans, and removed from the latrines by the small opening in the outer yard wall and carried away in night-soil carts. The dustbin for these small houses is generally an empty kerosine oil tin.

Another model is a typical section of an infiltration gallery. This method of collecting water has been used in a number of cases where a river having a fairly good depth of coarse sand can be obtained. The gallery consists of a drain composed of loose jointed glazed stoneware pipes laid in the stratum of sand or gravel which has not been disturbed and which is in or adjacent to the river-bed. The depth of laying is generally that at which the coarse sand and gravel are met with and varies from 15 feet to 20 feet. One end of the gallery terminates in a collecting well which is connected by a cast-iron pipe with a suction well from which water is pumped and distributed. The model shows the actual construction of the gallery. The upper portion of the trench for the gallery is sloped to a grade of 1 in 3. The last 10 feet is carried down vertically and timbered ; the stoneware pipes are then laid loosely jointed and the filling is made with stone graded from $\frac{1}{4}$ to $\frac{1}{2}$ inch for a depth of $2\frac{1}{2}$ feet, over which is laid $1\frac{1}{2}$ feet of fine sand and over that 2 feet of fine sand. The rest of the trench is filled up with the excavated sand.

Three models of wells were exhibited. They were (1) a covered well fitted with two semi-rotatary pumps ; (2) a covered well fitted with one single barrel pump, and two iron tanks provided with a discharge tap for each and (3) a covered well provided with the usual pulley and bucket arrangements.

Two models of house connections were exhibited. In the one case, the connection is made by a closed pipe from the house direct into the syphon trap pit. In the other case, an open drain is constructed leading the house sullage into the syphon trap.

Two models of fly-proof latrines were also shown—one by Major Forbes-Knapton and the other by Mr. Pillai.

AFTERNOON'S PROCEEDINGS.

Before proceeding to deal with the business on the agenda paper, the President said that he would like to put for the consideration of delegates one or two points about which some suggestions had been made to him. One was as to whether the Conference should meet annually or biennially. The delegates might also consider the question as to where the next Conferrence should be held. It had been suggested by one or two members that the Conference might meet next not in a presidency town, but elsewhere, where they might more conveniently discuss some of the smaller problems. The delegates might also consider if they could suggest the main subjects which should be discussed at the next Conference.

URBAN WATER-SUPPLIES.

Monsoon condition of the Hooghly river.

Major Clemesha read a paper on " The monsoon condition of the Hooghly river and the results of experiments on silt removal " (Volume II). In the course of the above paper Major Clemesha said :—

During this investigation a very large number of important, though small, mechanical points were settled. These, however, cannot be given in

this paper. The main conclusions from the above appear to be: (1) that the Ganges and the Hooghly system of rivers in Bengal contain a very large quantity of suspended matter during the rains which comes largely from the dry agricultural land; (2) rivers traversing a different kind of country to that of the Ganges basin frequently contain little or no silt in the rains; (3) the influence of the tides on the quantity of silt in a river water is considerable in any part of the river where the rise and fall of the tide is felt. In the case of the Hooghly, if pumping could be arranged to take place at high tide, a very much purer water would be obtained; (4) a single roughing filter without sedimentation or chemicals will give good results with an appropriate sand, using Hooghly water containing about 60 parts per 100,000 of suspended matter. Beyond this point the purification depreciates rapidly; (5) with water containing about 100 to 150 parts per 100,000, a little more than 66 *per cent* of the silt can be removed by a single roughing process; (6) with water containing above 200 parts per 100,000, 50 *per cent* is the maximum that can be expected of a single roughing process; (7) obviously, therefore, when dealing with a water containing more than 100 parts per 100,000 either double roughing or sedimentation with or without chemicals is necessary in order to obtain a water free from silt; (8) variation in the head on roughing filters does not appear to influence their purification capacity much; probably the best economic head is 8 feet, and (9) the grade of sand is the important factor in obtaining good results with roughing filters. This will probably vary with different rivers and therefore should be tested experimentally if a large roughing installation is in contemplation.

Major Clemesha in his introductory remarks said he must point out that the work done in the Hooghly hardly applied to rivers in other parts of India or even Bengal. An instance of this was that the river Hooghly contained a large quantity of silt, and in the same province there was another river containing hardly any silt. When a water contained more than 60 parts per 100,000 a single process failed to give an adequate purification. Water flowing through dry agricultural land, *e.g.*, Bihar, received more silt from the surface water than water flowing through paddy or jungles.

Removal of silt for purification of river water-supplies.

Mr. West then introduced his paper on the above subject (Volume II):—

This paper deals with the difficulties experienced in treating raw river waters for the removal of silt from the intake at the river to the final slow sand filters. Starting at the river it draws attention to the necessity for removing the coarser sediment from the water before it enters the pumps to prevent undue wear and tear on the working parts. A suggestion is made to provide some sort of a sludge pit and a fine gravel strainer to treat the water before it enters the pumps. This problem ought not to be beyond the ingenuity of the makers of mechanical filters. A floating filter of the pressure type which could easily be cleaned by reversing the current would seem to offer a suitable solution. It would be expensive to instal, but the benefit derived from it would probably be worth this extra expense. A point on which the greatest stress is laid throughout this paper is that a slow sand filter will only give the best results when it is worked under fairly uniform conditions and there are no violent changes in the rate of filtration or in the quality of the feed water supplied to it. To ensure a uniform rate of working it is now considered an absolute necessity that every slow sand filter should be fitted with an automatic controller which will regulate the rate of flow and register the loss of head. To get uniformity in the quality of the feed water the system of intermittent settlement should be replaced by continuous flow settlement and coagulants should be used to correct the influence of unusual turbidity and all water should be passed through a preliminary filter of coarse sand before it is permitted to go on to the fine sand filters.

Other points which have been dealt with are the use of coagulants, the destruction of algae by copper and ferrous sulphate, the bacteriological results of short periods of storage, dual filtration as practised at Leduin and Albany, and the general rules for the working and control of slow sand filters. Briefly the paper describes the general method of sedimentation and purification as at

present practised in the United Provinces and makes suggestions whereby the efficiency and the general results of the working of the present slow sand filters might be greatly improved.

Mr. West added that he thought it was possible to have some kind of arrangement by which the water could be passed through a strainer before it came through the pump.

Major Clemesha thought this would be particularly difficult. Mr. West's method of adding coagulants was very important but new to him. He thought copper could only be used to advantage for the removal of algae where there was little organic matter and where the water was tantamount to filtered water. He thought that the sand used in Madras experiments for the filtration of water was very uneven and accounted for the badness of results in that presidency. Calcutta and Howrah sands were the best to be had anywhere.

Mr. Hutton contested Major Clemesha's statement in regard to Madras water. The quality of a water-supply did not depend solely on its bacteriological purity.

Mr. Madeley observed in connection with the above paper that the sand required to give the best results varied with the nature of the water. He had constructed a slow sand filter in Madras for mineral water. An analysis was made of the water at the Guindy Institute and the water was declared to be equal to the best water obtained from European filters.

Mechanical Filters.

Major Clemesha next read a paper on "Mechanical Filters" (Volume II):—

The paper gives the results of the bacteriological examination of rivers in Bengal. The main conclusions are these,—Pressure filters give very poor results from a bacteriological point of view and cannot be relied on to make a polluted water safe ; Gravity filters give very good results and can be relied on to remove bacteria when the filters are reasonably well worked. The analyses given form the most interesting part of the paper.

Major Clemesha in introducing his paper said that as regards the Jewell filters those at Dacca had been examined carefully and the result as given in the report justified his remarks. So long as there was a man who was capable of managing boilers, etc., he was perfectly certain that there would be no difficulty in having the requisite amount of supervision necessary for mechanical filters. In the rivers of Bengal they could guarantee first class water, so far as bacteria was concerned, by the use of Gravity filters. There was the same objection to mechanical filters as to slow sand filters, *viz.*, that both occasionally failed, and therefore it was necessary that the water should be " safe " when it arrived at the filter. Every sanitarian was agreed on the point that the water should be reasonably safe when it arrives at the purification plant.

Mr. Madeley disagreed with Major Clemesha that the initial cost of rapid sand filters was considerably less than slow sand filters ; the relative cost depended largely on the cost of the land available, the cost of the materials for construction, etc. He thought that experience had proved that in the case of sand filters, the slow sand filters were much cheaper in capital cost than rapid sand filters. In Madras a new water-supply was being brought in through a covered conduit 4 or 5 feet below ground. A rapid sand filter required some 10 feet pressure at least to work properly, and this meant excavation under water which was very costly. The second alternative was to have a second series of pumps to raise the water to such a height that rapid sand filters could be placed above ground. This would also be very expensive, and they had arrived at the conclusion that in Madras the slow sand filters were the right thing.

Dr. Newell said:—

1. That all the pressure filters quoted on page 1 (of Major Clemesha's paper) were Jewell filters.

2. How did Major Clemesha explain the success that pressure filters had obtained in Britain with his condemnation of pressure filters on page 2 of his paper ?

3. On page 3 the author stated that in both plants Jewell and Paterson the method of alum was ' simple, automatic and accurate'. He thought this statement was only true of the Paterson for in the Jewell if anything happened to the

pump was it not true that the tap letting in the chemical was not altered and so therefore could not be automatic? The point here raised was that the chemical does not alter with pure water as it does in the Paterson.

4. That on page 4 under the head of disadvantages he states "In places where the amount of silt is very great, the amount of water required for washing may at times reach as much as 20 per cent. of the total output of the plant." Dr. Newell said that one of the worst waters was the Hooghly and any filter which required more than 5 per cent. of water for washing was a financial failure because it was a well known fact that the settlement time must increase in proportion to the quality of the water and the cleansing question was independent of it.

Mr. Disney said that he thought Major Clemesha had overestimated the quantity of water required for washing out Jewell Gravity filters, where he stated in his paper this "may at times reach as much as 20 per cent. of the total output of the plant." At the Dacca water-works, designed and constructed by Mr. Housden, Sanitary Engineer to Government, Eastern Bengal and Assam, of which Mr. Disney was in control for two years, the quantity of water used for this purpose was some 3·8 per cent on a 9½ hours run. Had the battery of filters worked continuously for 24 hours this figure would have been considerably lower. It was true the water in Buri Ganga river, the source of supply was not very heavily silt laden, as compared with the Sone or Ganges, but still it was fairly turbid at certain parts. The cost and trouble of obtaining alum was also somewhat exaggerated in his opinion. This should be procurable throughout the plains at a maximum cost of Rs. 100 a ton and on this basis the expenditure per 100 gallons of filtered water would be a fraction of an anna.

Mr. Rangaswamy Iyengar of Mysore followed with a paper on "Mechanical filters for town water-supply" (Volume II) of which the following is a summary :—

"The paper before you may be said to consist of two parts. The first part deals with the principles underlying a mechanical filter. Being an Engineer I have dealt mostly with the engineering features. In the second part, I have given a very brief account of the existing installations in the Mysore province. The first mechanical filter to be erected in India was the one put up at Bethamangala, by the writer for the water supply to the Kolar Gold Fields in the year 1903. Mysore had thus taken the lead in introducing this system of filtration in India. Our late Sanitary Commissioner, Lieutenant-Colonel Smythe, took much interest in these filters, and on his recommendation and after a lengthy correspondence Jewell filters were subsequently also adopted for the water-supply to Bangalore, both the city and the Civil and Military Station. Jewell filters for the water-supply to the city of Mysore has been recently sanctioned. My opinion of these filters is that they are eminently suitable to handle the river and tank waters in the Mysore province. These waters contain a very large percentage of fine suspended silt which I may say is in a state of semi-solution. Ordinary sand filters were unable to yield a satisfactory filtrate. The question of wash water required, cost of operation, etc., etc., have been dealt with at some length as I thought the members of this Conference would be glad to know the actual results of a plant that has been in operation for some years. In the case of the Bangalore plant the mere cost of filtration amounts to 5 pies per 1,000 gallons, and if we add depreciation charges, etc., the cost works out to 9 pies. As regards the wash water I find that the Jewell filter uses no more water than the old sand bed filters. I shall be extremely glad to know if my observation coincides with the results obtained in other installations. I may be permitted to add that we are in position to gauge this with a tolerable degree of accuracy, as the inflow and outflow are measured by venture meters. The difference between the two readings represents the loss due to washing, etc., and this is balanced daily and checked monthly. I would like to say a few words on the water supplies to the towns of Shimoga and Harihar. The feature to which I draw special attention is that in both cases we pump directly into the town. For the purpose of distribution the town has been divided into four or five districts, and each district provided with a balancing masonry covered tank

provided with taps on the four sides. There is also a limited distribution for these tanks by means of the ordinary hydrants. We have not attempted to provide a fountain at stated distances apart. Pumping continues throughout the day at a uniform rate and the system is thus maintained under pressure. During the hours of main demand the tanks feed into the mains and maintain the supply. We always manage to shut down every night with the tanks full. At first we had some difficulty in regulating the flow into the five or six tanks which were scattered all over the town, but by gradually manipulating the valves we now experience no such difficulty. I shall be glad if the members of the Conference will give their experience of the working of similar installations elsewhere. You will also see that as regards the item of working expenses the two systems compare very favourably with the similar installations in the Madras presidency. At Harihar the cost per 1,000 gallons is As. 5·5 after allowing all charges and at Shimoga it comes to As. 9·7. The filtered water in Bangalore costs us 10 annas per 1,000 gallons after allowing for depreciation. The source of supply is 14 minutes away from the town and it is pumped against a head of 400 feet."

Mr. Madeley said he had had the privilege of seeing the Bangalore waterworks and had found them very instructive. The wash water there required was 5 per cent. But there was a loss due to evaporation, etc., which was very high. He would like to enquire whether there had been any trouble with the breaking of the stirring arms, and whether the nipples which received the water after filtration got blocked up. Another question he would like to ask was why the rapid sand filter could not be cleaned in the same way as the slow sand filter, by scraping the surface.

Major Clemesha thought that the remark in Mr. Iyengar's paper, that a slow sand filter never failed, was rather too strong.

Mr. Iyengar said they had had no trouble so far with the stirring arms though they had had them in use since 1903. As regards cleaning mechanical filters in the same way as slow sand filters, in the mechanical filter, working with a head of nearly 12 feet, the sediment permeated to a depth of as much as a foot or a foot and a half, and simple scraping would not suffice. In regard to wash water, they had kept a very careful account and it was normally 2 per cent. but for about two months in the year, when the water in the lake got very muddy, it rose to 3 or 3½ per cent. The maximum might safely be put at 3 per cent. and the average at 2 or 2½ per cent.

Captain W. C. Ross mentioned, with regard to Mr. Madeley's question about the cleaning of mechanical filters by scraping, that in his experience of Jewell filters in collieries, where the supply of water is taken from pumps, and the coal dust forms an easy means of showing the penetration he had opened up and seen a filter in which the penetration of coal dust was actually between 18 inches and 2 feet.

Jewell filter at Naini Tal.

Captain Dunn then read the following note on "The Jewell filter at Naini Tal" (Volume II).

"The Naini Tal water-supply consists of a series of springs, the majority of which show signs of pollution. The water from these springs is filtered through a low type steel Gravity Jewell filter. This filter was installed in order to remove, if possible, the deleterious organisms which were found in the raw water from time to time. A report on the efficiency of the filter was required by Government and for the purposes of this report the investigations detailed in the paper were carried out. These tests were carried out over a period of nearly five months under varying meteorological conditions. The results obtained appear to prove that (1) the installation as it was being worked by the municipal board was inefficient, (2) on increasing the amount of sulphate of alumina added, the efficiency was greatly increased but that coliform bacilli could still be recovered from 1 c.c. of the water which had passed through the filter; and that therefore this system of filtration is not an ideal one for the class of raw water to be dealt with in Naini Tal although it has been found most efficient elsewhere."

Captain Dunn, in introducing his paper on the Jewell filter at Naini Tal, said that Captain Wood and he had carried out tests for four or five months and

the results were contained in his paper. In Naini Tal they had to deal with a particular type of water, *viz.*, very clear hill water. Every test that they could think of was gone through in order to give a fair result as to the efficiency of this filter and they thought that they had established the fact that for clear water of the description dealt with in Naini Tal the amount of 1 grain of sulphate of alum to the gallon was quite insufficient. They found that the use of 2 grains per gallon gave better results, but unfortunately these latter experiments were very limited. In answer to a question, he thought it was impossible to clean the jewell filter in the same way as the slow sand filter.

Infiltration galleries.

Mr. Lacey next introduced his paper on "Infiltration galleries in the Madras presidency," (Volume II) of which the following is a summary :—

There are altogether ten infiltration galleries in the Madras Presidency and they may be divided into—

I. Shallow infiltration galleries.

II. Shallow infiltration galleries and wells.

III. Submerged infiltration galleries.

The following are the towns which are supplied from infiltration galleries :—

I. Shallow infiltration galleries—1. Conjeeveram, 2. Cuddapah, 3. Dindigul, 4. Gudiyāttam. 5. Nellore and 6. Guntūr.

II. Shallow infiltration galleries and wells—1. Tirupati, and 2. Trichinopoly.

III. Submerged infiltration galleries—1. Madura and 2. Tanjore.

Three typical infiltration galleries were described, *viz* :—

1. *Cuddapah water-supply.*—The nature of the soil and sub-soil at site of the gallery are described by Major Drake Brockman, the Executive Engineer who drew up the scheme in his report embodied in Government order, dated 6th July 1885. This gallery was the first put down in the presidency and has supplied a town of 18,000 inhabitants for 22 years.

2. *Tanjore water-supply.*—The nature of soil and gallery are described in Mr. Jones' letter, dated 2nd September 1891, as follows :—"The chief feature of the scheme is the manner of drawing water from the river-bed. The plan proposed is similar to that adopted for the Madura water-works. Both in the Vaigai and the Vennar there is a comparatively small depth of sand overlying the somewhat impervious kunkur. In the Vennar the depth is about five feet, and hence an ordinary filtration gallery would not be suitable as the supply, when the water level was much below the top of the sand or river bed level, would be scanty. Hence a filter bed formed of small tubes of tiles laid in a trench, cut right across the Vennar, 300 feet long and 50 feet broad, has been designed. The filter bed extends from one side of the river and is 50 feet in breadth along the river. The area of 300×50=15,000 square feet will, it is believed, give an ample supply to the pumps. There is, it is believed, every assurance that enough water can be obtained at all times of the year and the reports as to the purity of the supply are no less satisfactory. The Chemical Examiner says, as the result of an examination of three samples of the water in April last, which samples were taken from wells in the river where the filter bed will be situated "the water is clear, very slight sediment and in most respects good."

3. *Conjeeveram water-supply.*—The nature of soil and the gallery are described in Mr. Jones' letter, dated 6th November 1893, as follows :—"At the point selected for the site of the headworks the river-bed is 1,000 feet wide, and its sandy bed, as ascertained by trial pits, is some fifteen deep. The summer water level falls as low as eight feet below the surface of the sandy bed and this, it is believed, is the lowest known summer water level. It was taken when the river was at its lowest in the year 1891.

It is not possible to gather any more particulars on this point without extensive experiments as to the yield of water from a trench similar to the one

proposed and hereafter to be described. But when it is considered that thousand of acres of land both above and below Conjeeveram are irrigated by spring channels cut from the bed of the river, there is not much doubt, but that a sufficient supply of water for the town can be obtained at all times. After careful consideration as to the most suitable plan for collecting the water from the sub-soil, it is proposed to do so by laying four lines of open jointed 9-inch stoneware pipes in a trench at right angles to the axis of the river and at a depth of seven feet below lowest known water level, this trench commencing from the river-bank where the engine house will be located will extend a distance of 550 feet. The trench will be refilled up with gravel up to the summer water level and above that with river sand. More than one method was designed and actually estimated for, but it was finally decided upon to adopt the above method as being the most suited to the circumstances of the case. The method of drawing water has been successfully adopted at Cuddapah. It is not suited to any river with a sandy bed which is liable to scouring by high floods. The highest floods in the Vegavati have not been found to exceed 3 feet.

The area of the openings in the proposed gallery at Conjeeveram is calculated to be 46 square feet. The maximum inflow per minute is to be 1,166 gallons or 186 cubic feet which will require a velocity 0·8 of a foot per second.

Mr. Hutton followed with a note (Volume II) on "Infiltration galleries" from which the following are extracts :—

"An infiltration gallery, when constructed across the direction of flow of underground water in a river-bed, enables us to obtain much larger amount of water than would be obtained from wells sunk in the river-bed, a considerable distance apart. It is thought that wells would require to be put so close as to actually abut each other before such wells could supply an equal amount of water to an infiltration gallery. This would mean that the infiltration gallery would be cheaper in construction than such wells when placed close together. If it were proposed to sink wells in a sandy river-bed at a considerable distance apart say, 300 feet, it would be necessary to connect up these wells either to a common suction pipe or to a common syphon pipe. These pipes would then be located at a higher level than the bottom level of the wells and at this higher level such pipes would be liable to damage by the scouring action of flood water. In the Trichinopoly water-works we have an arrangement of three wells joined to a common suction pipe and this pipe has not only been carried away twice in the last nine years, but its presence at a comparatively high level above the bottom of the wells has given us constant anxiety for its safety. In the case of the broken stone filling of a gallery I am of opinion that in order to discourage movement of sand surrounding the broken stone it is an improvement to lay this broken stone filling, in decreasing sizes from the stoneware pipe in a similar way to the filling of a sand filter. A well possesses this advantage over an infiltration gallery. Silt in the well or fine sand can be removed by means of a sand pump or a grab dredger. If silt has to be removed from an infiltration gallery, this can only be done by actually removing the broken stone and relaying the same stone, after it has been cleaned. The silting of an infiltration gallery appears to be due to the presence of fine sand and silt in the river-bed. Where the quantity of this is large as at the Trichinopoly gallery, where it is 12 per cent the silting of the gallery and also of the wells has been an undoubted fact. In the case of the Conjeeveram gallery the sand at depth is coarse, and there has been no trouble from silting and no reduction in the quality of the water since the works were constructed fifteen years ago."

The Puech-Chabal system of water filtration.

Mr. West then introduced his paper (Volume II) on the above subject of which the following is a summary :—

This paper describes briefly the Puech-Chabal system of multiple filtration as installed at Cawnpore and gives the reasons which led to its adoption. The cost of the final estimates for the Puech-Chabal installation is compared with the preliminary estimates for extending the supply on their present system. No fair estimates for the extension on the present system were prepared, but

the preliminary estimates were based on the actual cost of construction as found by experience, so may be taken as approximately correct. Sufficient guarantees would appear to have been provided to ensure satisfactory results from the final filters in the Puech-Chabal system. The advantages which the municipality expect from the adoption of this system, are :—(1) the total saving in the cost of coagulants used during the monsoon period and (2) a large saving in the cost of new sand, sand washing and establishment. It is expected that the savings so made will be more than sufficient to justify the extra expenditure incurred. The trials of these filters which have just begun will last over a period of twelve months. The results will be furnished next year when it will be seen how far these expectations have been fulfilled. In the Puech-Chabal system, as installed at Cawnpur, the water passes through three sets of gravel strainers and one set of coarse sand preliminary filters before it reaches the final slow sand filters. Cascades for aërating the water are provided between each set of gravel strainers and between the last set of gravel strainers and the coarse sand prefilters. A system of cleaning these gravel strainers by means of compressed air is also provided. The installation, it will be noticed, is very complete in every way and the result of the year's trials will be looked forward to with interest by many Indian municipal bodies who have turbid waters to deal with.

After introducing the paper, Mr. West showed samples of water taken in different bottles and a description of the various straining processes was then given. He said that it was premature to pass any judgment, but the results of the fifteen days' working were so far very good.

Major Clemesha said that the plant was an ingenious one, but his objection was that it was extraordinarily costly. He wished to know whether the same results could not be obtained by raising the settling tanks. The system cost something under two lakhs of rupees, and he thought that a simpler process between the settling tanks and the filters could be installed for Rs. 80,000 for similar results.

Mr. West explained that the system was for treating raw river water and that there was no necessity for using the settling tanks.

Tube-wells.

The following is a summary of the paper next introduced on "Tube-wells as a source of public water-supply," by Mr. Miller Brownlie (Volume II) :—

Mr. Miller Brownlie gives two statements showing the relative cost of supplying a small town of 6,000 inhabitants with 16 gallons of water per head per day from ordinary walls and from tube-wells. He takes as the basis of his calculations—(*a*) that ordinary wells for such a supply will have to be at a distance of at least half a mile from the village, while the tube-well may be inside the village area ;(*b*) that 4 masonry wells, each 12 feet in diameter, will be required as against one 5-inch convoluted tube-well with tubes in duplicate. On this basis he shows that the advantage is with the tube-well to the extent of 50 per cent in initial cost and 33 per cent in maintenance. He states that the 12-inch and 15-inch bore tubes required for the larger size of tube-wells can be easily sunk by a water jet at the rate of 10 to 15 feet per day to depths of 200 feet. He recommends the use of the Ashley tube-well pump where the spring level is considerably below ground level, as it works well in the tube without any special chamber or masonry well, to depths of several hundred feet, and is easily removed for inspection and repairs. When this pump is used the tube-well should be carefully shrouded to prevent any powdery sand reaching the valves. He then compares the different types of tube-well including the convoluted tube-well of which he is the inventor. With the saving shown above by using tube-wells instead of ordinary masonry wells, he holds that there should be no difficulty in carrying out water-supply schemes for small towns and villages.

Artesian and sub-artesian supplies of water in Guzerat.

Mr. Belvadi then read a paper (Volume II) on the above subject and said:—

" Considerable difficulty is at present being experienced in most parts of the Bombay Presidency in providing pure and sweet water for domestic purposes.

The configuration of the ground does not lend itself to the construction of large storage reservoirs, the shallow wells which are at present the principal sources of water-supply are, as a rule, contaminated with sewage and sweet water wells are practically unknown in the tracts bordering the sea coast and the natural salt water lake called the Nal. The geology of Guzerat has not been systematically studied yet, but it is expected that water bearing beds of sand stone and schists of the Cretaceous age are found at not very great depths below the surface, overlying the older rocks of the Aravalli series. To ascertain the capabilities of these sand stones and schists as water bearing rocks and to study if the structural conditions of these beds are favourable for the existence of artesian reservoirs, the Government of Bombay have carried out some deep experimental borings with up-to-date plants. The boring plants are all of the Calyx type and capable of boring to depths of 250 to 4,000 feet. The boring work is still in progress and we must wait a couple of years to gain some definite knowledge of the underground resources of water-supply, but the experiments made, so far, are interesting in themselves showing the existence of large volumes of water in the tertiary clays and marls immediately over-lying the sand-stones. Two experiments show striking results. The exposure in quarries and wells shows so little inclination of the beds underlying the surface strata that no one could say with certainty that genuine artesian conditions prevailed in the vast alluvial plains of Guzerat. At Viramgam, in the Ahmedabad district, an artesian stream was struck at a depth of 378 feet below the surface of the ground which is only 88 feet above the mean sea level and water has been flowing out of the bore tube under a head of 14 feet. The rate of flow is as much as 8,000 gallons per hour, normally, through an 8-inch tube and could be doubled if a powerful air-lift were used. The water is, at present, being pumped up to a higher level reservoir and is utilized for domestic purposes. At Kharaghoda, about 21 miles to the north-west of Viramgam where every well is brackish, an excellent artesian supply rising 58 feet above the level of the ground was met with at a depth of only 256 feet below ground. The flow was gauged to be over 15,000 gallons per hour, the delivery being through a 6-inch bore, a result which even the most sanguine did not anticipate. The Bombay Government propose to pierce through the tertiary clays into the water-bearing sand stone below, and the result will be awaited with considerable interest. If, as is expected, the existence of copious and better artesian reservoirs at reasonable depths below the ground surface is established, the difficult question of supplying good potable water to a large tract of country, which is, at present suffering severely from scarcity of sweet water, will be satisfactorily solved."

THIRD DAY, NOVEMBER 13.

FORENOON'S PROCEEDINGS.

The Conference resumed its sitting at 10-30 A.M.

The President announced that His Excellency Lord Pentland had intimated his intention to attend the Conference and meet the members in session on Saturday afternoon. He was sure that the delegates to the Conference would appreciate the kindness of Lord Pentland in taking such great interest in their work, notwithstanding several claims on his time.

WATER-SUPPLY AND DRAINAGE SCHEMES.

The financing of water-supply and drainage schemes in Bombay.

The first subject dealt with related to the recent resolution (Volume II) of the Bombay Government regarding the financing of water-supply and drainage schemes.

The Honourable Mr. Curtis said :—" I must apologise for the form of my remarks. I had intended to write a paper dealing with the subject of water taxation in the various provinces of India, and with that purpose I addressed enquiries to various Sanitary Boards. Answers have not yet come. Furthermore, I only received intimation of this discussion four days ago, since when the offices have been shut, and I have been unable to obtain various publications of which I stood in need. With this preface I will make a few remarks on the Bombay Government resolution now before you.

The first part deals mainly with accounts. Now it may seem absurd that there should be any difficulty about ascertaining the exact financial position of any municipal enterprise in the direction of water-supply; but the fact remains that both in Bombay and, I believe, in other provinces the accounts are far from clear on the subject. On the revenue side a large part of the revenue is often received from an enhanced tax on rental value or there may be a special tax on articles imported, such as ghee, or bales of cotton, or there may be revenue from rates for gardens, rates for factories, rates paid by arrangement with railways, but is rarely or never the case, in my experience, that revenue due wholly and solely to the supply by the municipality of that important commodity, water, is shown separately in any publication. The same remarks apply to the expenditure side. There is no definite capital account. We see sums spent from year to year on maintenance, part of which we may guess should go to capital account; but we have no information. In the same way as regards the expenditure in the loan account; we have no information ready to hand to show whether the money has been borrowed in the open market or whether it is from Government; whether the period of the loan is 20, 30 or 40 years; whether any sinking fund has been arranged for and, if so, in what way; and so forth. There is nothing clear to show how money spent on water actually goes out. It will be seen from the Bombay Government resolution that Government have recognised the difficulty which arises in this case, and have now arranged to have the accounts prepared and kept up yearly by experts deputed from the Accountant-General's Office. That of course will enable us to see at once how schemes already in existence started, and how far, on the financial side, they have been successfully managed.

I now turn to the second part of the resolution which deals with the supply of water as a commodity from a commercial point of view. It is perhaps advisable to explain how this subject assumed prominence. As you know, in the last five or six years the Government of India and local Governments have been able to set aside special grants for the encouragement of sanitary schemes. There has also at the same time been a widespread and genuine desire among the inhabitants of larger towns to obtain installations for water-supply and, consequently, a good deal of competition for a share in the Government bounty. This has

necessitated a careful examination of the schemes put forward by various municipalities, in particular as to whether proposals to tax themselves are adequate and whether the poverty which they so often alleged really exists. Incidentally, too, the matter has assumed importance in another way. Many of you will have read the interesting report on octroi which was published by the United Provinces Committee about two years ago. That report asserted the necessity for the maintenance either of octroi, or of some form of taxation resembling octroi, such as a terminal tax. In Bombay we were not prepared to accept their conclusions and we have been endeavouring to see whether by developing other sources of revenue, for instance, increasing the charges for water, we should be able to minimise the abuses which seem to us necessarily inherent in octroi. From this it comes that we have evolved conclusions which we placed before the Bombay Government, and the copy of the letter is now before you. To show how widely this differs from conditions of existing installations, I will relate to you a personal reminiscence. Twenty-four years ago I was sent as an Assistant Collector to Ahmedabad. A proposal to establish water-supply was then under consideration, and it evoked such animosity—I might almost say fury—among the lower classes of the city that the President of the municipality had to be escorted backwards and forwards from his residence to municipal meetings by the police to save him from bodily injury. I mention that to show how things have changed. The installation in that town was finally completed in 1891, but having regard to the novelty of the installation and the temper of the people, no attempt was made to impose anything but a very light tax on rental values. The authorities, in fact, followed English principles. Now it is all very well to follow English principles, but if you are going to do that, you must follow English practice and really impose a substantial tax. In an English town a common rate will be 7*s.* 6*d.* in the pound, or 33 per cent. Nowadays, even 50 per cent. is not unknown, but in an Indian town 10 per cent. is the limit; 8 per cent. is common, and of that not more than 2 per cent. is ordinarily taken as the water share of the consolidated rate. The result is that in towns where the charge for water is based on rental value, the proceeds are sometimes ludicrously small. In Ahmedabad, for instance, the total revenue from water is about Rs. 1,57,000, and yet there are nearly 26,000 houses with half-inch connections. Allowing for the profits of water sold to the mills, the average charge per connection does not probably exceed Rs. 3, which is insufficient to pay the pumping expenses of the water. Considered as a business proposition, the Ahmedabad water and drainage works, if my memory serves me right, pay a dividend of only 2 per cent. on the capital. In other words, commercially speaking, the installation at Ahmedabad is a failure. In the 20 years which have elapsed since those water works were started, the population of the city has doubled and the number of mills has increased from 7 to 50. There can, I think, be no question, that if a private company had started the supply of water in 1891, they would have adjusted their charges without in any way causing discontent, so as to yield by now a dividend of 10 per cent. and the natural growth of the city with its attendant demand for water, must have driven their shares to a very high figure. As it is, the revenue from water barely covers expenses.

Now this I mention as an object which we determined to avoid. We determined to try and fix a rate for half-inch connections, that is to say, connections taken by households of the upper and middle classes, which should furnish say 60 to 70 per cent. of the gross revenue which we wish to make; and this rate we fixed at first tentatively, at Rs. 12 per half-inch connection, *viz.*, Re. 1 per month. That is to say, we assumed that the average house would consume 4,000 gallons of water at 4 annas a thousand gallons. However, no sooner had we fixed this than we found that there were several municipalities willing to go higher. The Poona municipality set the example by raising the rate to Rs. 24; Ahmednagar and Barse have accepted a similar rate. Sholapur has accepted a rate of what is practically Rs. 18; but when we came to go into the matter still more deeply, we found that even so high a rate as Rs. 24 represented to the ordinary householder a considerable economy on his present expenditure in water. The extent of this expenditure is perhaps not generally realised. It will cost a householder at least Rs. 3 a year in pots and ropes to fetch his water, and in every house belonging to a member of the upper and middle classes, outside labour is

employed to the extent of at least Rs. 30 yearly to fetch water from the nearest source. From this it follows that Rs. 24 can be willingly paid by any one who in ordinary course, would take a connection pipe. Now, this seems a very simple fact to discover, but simple as it is, it has made a great difference to the ease with which schemes for water-supply are financed. An actual instance will explain what I mean. The water scheme for Ahmednagar is estimated to cost Rs. 7,40,000. Assuming that Government pay half, Rs. 3,70,000 will have to be found by the municipality. This means an equated instalment, capital and interest on a 20 years basis, of about Rs. 26,000. Expenses will amount to another Rs. 6,000 (it is a gravity scheme), total Rs. 32,000. Now, with a Rs. 24 rate for connections, we may assume that the revenue from that source will be at least Rs. 11,000; there will be Rs. 6,000 in economies on existing expenditure, which will leave only Rs. 5,000 to be made up from a general tax on smaller houses, from which and other sources, such as sale of water to gardens, factories, etc., we may well hope to make another Rs. 10,000. The result will be a small profit on the scheme which can be used to meet the cost of the drainage scheme which should of course be the concomitant of a water scheme. If the sanction of the superior authority be hereafter obtained to the extension of the period of the loan from 20 to 30 years, we shall have at once a reduction in the annual charges on loan account of Rs. 6,000, which, with the profit yielded by the rates, would go far to meet the expenses of the drainage.

I feel that I have taken up a good deal of your time in demonstrating the obvious and I trust that you will pardon me. I do not pretend that the plan that I have outlined is in any way ideal. In an interesting note read by Mr. Hutton yesterday, he proposed that every house should have its own meter. Of course this is the ideal arrangement, but the cost of meters is high. If in a town of 5,000 houses 2,000 take connections, the cost of meters at Rs. 50 a connection would be a lakh of rupees, which means that the cost of the water-supply will probably increase from 4 to 5 lakhs. That is an objection. There are others, with an ordinary connection rate you can insist on payment in advance, and if a householder does not pay, the supply can be cut off promptly. With a meter rate, money is only collected after the water has been consumed. From the point of view of convenience of administration, there is no question but that the connection rate is by far the best."

In reply to Dr. Nair, Mr. Curtis said that though the bulk of the revenue should be from half-inch connections, there was no objection to additional income being derived from a small assessment based on rental values.

Mr. Pillai said that the principle of levying water-tax at Rs. 18 for half-inch service had the following advantages :—(1) the revenue was certain and (2) there would be a considerable reduction of wilful waste. Cases where people used water for non-domestic purposes naturally came under the control of meters and charging for the excess used beyond the quantity allowed by the Rs. 18 rate fixed for the service. In the system of indiscriminate meter fixing there was considerable room for leakage.

Mr. Belvadi said that the present method of raising revenue to defray water charges by imposing a general tax calculated at a fixed percentage of the rental value of buildings really had the effect of shifting the burden on to the poorer classes of population who were unable to bear it or of raising the scale of octroi and other duties to the great prejudice of the trade of the town. Water as a commodity in all civilised countries was supplied by private companies who made considerable profit and there was no reason why municipalities in India should not endeavour to run their water-supply schemes on commercial rather than philanthropic lines as they were practically doing at present. It was obvious in his opinion that by discarding the method of taxing on rental values a very large accession of revenue would be secured and municipalities would be in a position to utilize the surplus revenue in effecting further sanitary improvements to their towns, without resorting to additional taxation. At the same time they would be enabled to supply water at nominal rates to the poorer classes through public stand posts and cisterns.

Dr. Nair, in opposing the adoption of the Bombay system, said that in European cities water-supply was very often undertaken by private capitalists. At

the present day, however, the European cities were realising more and more what were their municipal duties and responsibilities. He hoped that they would not go back to the theory that water-supply was a private duty and not a municipal duty. In this part of the country it had been recognised that the supply of adequate drinking water was a municipal duty. If it was recognised as a municipal duty, he did not think that a municipality had a right to look on the water-supply purely as a commercial concern. He quite understood the principle that anything outside the scope of necessary domestic purposes ought to be made a commercial concern. In a country like India, where water was required more than in colder climates, he did not think that the domestic water-supply should be considered a commercial concern. The principle of levying taxation for water-supply on the annual rental value of buildings was a sound one, and that was the only satisfactory criterion to go by, because to a very large extent, a man's financial capacity was indicated by the house which he occupied. He was rather surprised to hear from Mr. Curtis that the accounts connected with water-supply had got into a muddle in Bombay. If a municipality wanted to have a water-supply, the procedure was to formulate proposals and obtain the sanction of Government. Under such control, he could not see how the accounts got into a muddle. He was sure that in this part of India, the proposal to adopt the Bombay system would meet with very strong opposition. Madras would prefer to continue the present system. Mr. Curtis' plan was open to the objection that under it rich and poor would pay alike since there could be no difference between a rich man's connection and poor man's connection.

Rai Bahadur Ganga Prasad Varma observed that if the commercial principle was introduced many house-owners would not have house-connections. This difficulty would in particular arise in municipalties where the water was of poor quality. The principle, however, was capable of enforcement in certain municipalties, *e.g.*, Muttra and Agra, where much expenditure was incurred in carrying water or in Mirzapur, where there is often a water famine.

Mr Hutton welcomed the Bombay proposal which, he thought, was long overdue in Madras. He considered, however, in regard to ¾ inch connections, that there might be many instances of wastage and that meters might still be required in mufassal municipalties.

Dr. Master said that he agreed with Dr. Nair that in India, particularly in the poorer cities, the supply of water on a commercial basis was not desirable, because people would try to save every pie for the use of water with the result that insanitation would arise. They had had sad experience of that in Bombay. If meters were provided poor people would try to save as much money as possible and stint themselves of water. The question of supplying meters had been considered in Bombay and the conclusion arrived at was that in the present state of ignorance prevailing in the country, meters were not desirable.

Mr. Williams was under the impression that the Bombay proposal would in any case only be successful in a few municipalities in Bengal. The question, he said, lay between a much larger supply of water with a possibility of getting back a substantial portion of the cost from the sale of water, and that of a smaller supply the cost of which would be defrayed mainly from taxation and possibly from the sale of excess water or meter rates, etc. He quoted figures to show what would be the total consumption of water in Bengal for a town of 35,000 persons with a thousand house connections. He thought that municipal accounts in Bengal were fairly accurate. Annual statements of capital expenditure were forwarded to him and in most municipalities they got a fairly complete history of water and drainage schemes.

Rai Bahadur Kailas Chandra Bose feared that the Bombay proposal might lead to the use of unfiltered water. He admitted that meters prevented waste but was of opinion that they should err on the side of generosity in the supply of water in India.

The President said:—" I think that there is some misunderstanding. Mr. Curtis is not asking us to introduce the system of the Bombay Resolution everywhere at once. Still less is it his desire to restrict the supply of water. His object is with the limited funds at disposal to secure that the supply of good

water should be extended as far as possible by economising resources. People who have not the advantage of a good water-supply will often pay highly to get this blessing. People getting a plentiful supply of water cheap will naturally object to paying more for it. I confess that I am impressed by the fact that the Bombay system has been tried with encouraging results. As regards the danger of unduly curtailing the supply of water there is a good deal of experience the other way. In many places the wastage of water has been so great and with such injurious results on the fever rate, that extensive and expensive drainage schemes have had to be introduced. I do not want to limit the discussion, but we have a heavy programme before us and I think that we should remember that there is no suggestion of immediate action elsewhere. Mr. Curtis has introduced us, if I may say so, with great ability, to a financial method of attaining the object which we all have in view, *viz.*, the extension of the supply of pure potable water. He asks that it should be considered—no more."

Mr. West said that figures giving capital expenditure and yearly cost of maintenance and revenue derived from the sale of water were available in the United Provinces municipalities. The method of recovering the water-rate was by an assessment at the maximum rate of $7\frac{1}{2}$ per cent and by the sale of water. In his opinion an extra charge might be levied for connections. A combination of these two methods was preferable to the Bombay proposal.

Mr. Madeley said that in Madras city the supply of water was very limited. They had decided that each *pucca* house should get a service. To prevent waste it is proposed to have two classes of service : first, a single tap which can be easily inspected and whose water-supply can be stopped without difficulty if necessary. This will be supplied free of charge apart from the taxation ; the second would be a more luxurious supply for those who wish to have several taps wherever they liked, though even in their case the taps would have to be restricted to a certain number. Rental values will be the basis of assessment. He thought this plan was better than the system of connections enforced in the Bombay municipalities.

Colonel Wilkinson thought the question of finance was at the bottom of all proposals connected with sanitation. The Sanitary Board in the Punjab were required to ascertain the financial position of municipalities before recommending sanction to sanitary schemes or allotting grants. But this ascertainment was an extremely difficult matter and financial statements were apt to vary to a startling extent from town to town. He asked whether there were any means of discovering the true financial potentialities of municipalities.

Mr. Curtis thought that data such as those required by Colonel Wilkinson could only be furnished by local officers.

Captain Justice stated that in Madras they had sufficient statistics for the purpose.

Major Lalor thought on common-sense grounds that the burden of proof should rest rather on a municipality to show that it had not got the means wherewith to finance sanitary schemes than with the superior financial authorities to show that such means were forthcoming.

Major Stokes said that the onus of explaining the financial position of a municipality rested on the Collector and the Commissioner in the Central Provinces. He thought that a definite recurring grant was the best method of spending money for sanitary purposes.

The President thought this was an important question which had been raised by Colonel Wilkinson, but that the only solution for discovering the exact financial potentiality of a municipality was by local enquiry.

With reference to Dr. Nair's remarks, Mr. Curtis said that he thought Dr. Nair had generalised too much from the case of the Madras municipalities. He thought that the main objection to assessment of rental values was that, in the first place, such values were often non-existent and, secondly, that they were assessed too low. He gathered, however, that in Madras there was a revising agency for assessments. In regard to accounts, he said that in Bombay many

of these accounts were thirty years old and therefore inaccurate. Water-supply accounts to be proper should be designed *ad hoc*. With reference to what Mr. Hutton had said, he remarked that there was no objection to a quarter-inch pipe, if necessary.

WATER ANALYSIS.

Recent researches in the method of water analysis.

Major Clemesha then introduced his paper (Volume II) on "Recent researches in the method of water analysis" and made the following remarks:—

"I should just like to point out that within the year very interesting work confirming our original conclusions has been done by Major Flemming in Coonoor. The Welcome Research Laboratory in Khartoum also are working on the same lines and have published some interesting and important results ; a certain amount of work has also been carried out in Allahabad. I wish to impress on the members of this Conference the two facts—(1) the ideas published in the Madras report of 1909 have been favourably reported on in other parts of the world and the work has received a certain amount of confirmation, and (2) that, while admitting that improvements in method will probably be evolved, it is necessary to go into considerable detail if the results obtained in the ordinary routine work are to be of use in explaining the phenomena observed in nature. During the last three or four years some of the ideas which were published in the King Institute report of 1909 have required slight modification, but speaking generally the main facts appear to have stood the test of further investigation very well. Of course a good deal of progress has been made and new problems have been investigated, it is one of these that I propose to discuss with you now, but the method in use is a sound one and its general adoption is therefore the more urgent. It has long been a debatable point amongst water-analysts as to whether the first stage in an analysis should be made with glucose or a lactose broth. MacConkey and Hill first started with a glucose broth in order to include Gaertner and enteric organisms. Latterly MacConkey decided that a lactose broth was better. Houston has always begun with a glucose broth. In the King Institute in 1909 an investigation was made putting every sample through both and the important conclusion may be given as follows :—(1) That in practically every case a very much smaller quantity of the sample of water gives acid and gas in glucose than in lactose. If it were possible to make a sort of rough average out of these 77 samples, it would appear that in the lactose broth all dilutions up to 5 c.c. gave acid and gas, whereas in the glucose broth dilutions up to ·1 of a c.c. gave the reaction. If each sample is examined in turn, it will be found that out of these 77 only about 6 show that the number of organisms is approximately the same in both broths. It may also be noted that all, except one, of these samples are taken from rivers or irrigation canals. It has been well known to water-analysts for a very long time that what we may call "the acid and gas line" in lactose broth series is nearly always lower than in glucose broth. (2) A careful scrutiny of the results obtained from the separate colonies is also necessary. In the first place, out of 770 colonies obtained from a lactose broth not a single one was glucose minus, that is to say, in this investigation all fæcal lactose fermenters ferment glucose. On the other hand, the organisms grown in a glucose broth and plated on a lactose medium show very different results. A very small percentage ferment neither glucose nor lactose ; no systematic study has been made of this small group up to the present. They are organisms which are obviously able to grow in a glucose broth without fermenting that sugar. It should be observed that these samples were taken during July, August and September 1909. It is not maintained that the relative percentage of the three classes of organisms is constant at all times of the year. In fact, we shall show later on that this is not the case. These results were subsequently confirmed by a year's work on the Calcutta water and the Hooghly, the conclusions being practically identical with those arrived at from the Madras work. Again a careful scrutiny of Houston's results shows that the same thing applies in England, particularly it is noticeable that the class of bacteria which are glucose+lactose are much more

prevalent in summer than in winter. Considering this mass of evidence we may consider that the following points are fairly certain :—(1) that the acid and gas line glucose medium is higher than in lactose for ordinary natural water; (2) that the relation between the two classes of organisms varies at different times of the year; (3) that the relation between the two classes of organisms seems to be in some way connected with the amount of storage, or exposure to the sun. It is not maintained that a study of the acid and gas line in any sample of water will tell an analyst everything he wants to know, but at the same time in many samples of raw water (the same does not apply absolutely to waters that have been in pipes) to ascertain the time when pollution was added is a very important point, and the use of the two broths will give very valuable evidences on this point. It may be argued that here again we have added another additional complication to the already cumbersome routine of water analysis. In answer to this one has to say that for ordinary routine work a study of the lactose fermenters present is sufficient, but there are instances when every particle of evidence is required to confirm an important opinion, and there can be no doubt whatever that a study of the relative number of the two classes of bacteria will give much valuable and accurate information."

Dr. Turner wished to know whether the combination of lactose fermentation and glucose fermentation was invariably due to pollution.

Major Clemesha considered that such was very generally the case, but that at the same time other investigations would be necessary. Moreover the pollution referred to was not human pollution but recent pollution.

Analysis of the water-supply of Calcutta.

Rai Bahadur Kailas Chandra Bose next introduced his paper (Volume II) on "The water-supply of Calcutta, its present system of analysis and its disadvantages."

It is pointed out in the paper that, while the prevalence of what are usually considered water-borne diseases appears to be on the increase, the water analyses, by the recently adopted method show that the water is quite satisfactory. This has caused some distrust of the present method of analysis and it is suggested that it would be better to revert to the method previously in use to which the people were accustomed and which was easier to interpret and understand.

Analysis of potable waters in the tropics.

Dr. Maitland Gibson followed with his paper (Volume II) on "Water Analysis in the tropics with special reference to the adoption of standard methods in the collection and examination of samples."

The following is taken from the paper :—

" In past discussions in India on this subject, a good deal of energy has been used up in championing the views of one bacteriologist against those of another, as to what is the best indication of excremental and dangerous pollution and as to what are the best means of detecting it. A very vital point, namely, the climatic conditions under which the method would have to be worked has however been largely lost sight of. These conditions may affect our potentiality in opposite directions. In most parts of India, for instance, it is practically impossible to use gelatine media at all times of the year, unless under very exceptional circumstances. This is a very great handicap more especially in some of the more delicate confirmatory tests. On the other hand, tropical climatic conditions induce a selective action in what may be called "natural purification processes" such as has not been noticed in temperate climates. This at once enables us to differentiate between pollution of recent date and that of old standing, and justifies us in carrying out routine work in greater detail than is usually the case in Europe. On the whole I think a modified MacConkey's method will probably prove to be the best suited to tropical conditions, but there are one or two important points in connection with this method which must be borne in mind. (1) Being an enrichment method, the results got from it can only be considered qualitatively as regards any particular germ and more stringent precautions

should, I think, be taken to prevent the swamping out of delicate forms by more robust and quicker growers either in actual fact or as observed, than is usually done. (2) Its analytical value has perhaps been overestimated. In Europe where water famines are rare and communities are wealthy and can afford to go in for effective precautions against great fluctuations in the quality of drinking water-supplies, a less precise definition of what constitutes pollution may be all that is required, since it can be confidently stated that such pollution, even if present in the water from the source, will not be present in the water as distributed. In India where the conditions are quite the reverse, it becomes necessary to be more precise in the distinction between recent and therefore potentially dangerous pollution, and old standing pollution which cannot be got rid of but which would condemn the water from the European point of view. Certain objections against the MacConkey's method were raised at the Conference last year, but there seems to have been some confusion of thought with regard to these. It was held that the method took too long and that by the time the results were reported, all the conditions might have altered and effective action could not be taken. From this point of view, it is necessary to define what a properly conducted analysis can show. It can only show and it ought to show the condition of the water at the time the sample was taken. No method therefore, however short, conveys any guarantee as to the state of affairs when the report is presented. Further it was held that the greater elaborateness of MacConkey's method made greater demands on the efficiency of the filters and their management than would a shorter and less precise method. Surely it is obvious that the more we differentiate between one form of pollution and another, the more we will be able in the case of a given group of water-supplies to limit the number containing specifically dangerous pollution, and the greater number we will be able to pass as fit for consumption. Specific instances were given where the filtered water was shown to be worse than the unfiltered water. Such a showing cannot be attributed to the method employed; it would be shown by any method. After discussing these more or less general questions we may now proceed to special ones and we should first ask ourselves—what are the objects at which we are aiming in carrying out water analysis at all, and how may these objects be most efficiently attained? Our objects are—(1) to investigate new supplies, (2) to control and ensure the proper management of existing supplies and (3) to establish standards of bacterial and chemical purity which should be attained wherever possible. The question arises how often should a water-supply be visited and examined? Considering that the results can only refer to the moment when the sample was taken, the maximum effect in controlling the proper working of the filters, tanks, etc., would be attained by visits at irregular intervals, according to circumstances, and without previous warning. Further, if any permanent benefit is to be expected from these examinations, it would be necessary to take effective action should such be shown to be required. In the Madras presidency and probably in most other parts of India, the chemical features of drinking water cannot be ignored and the methods of chemical examination stand greatly in need of modernising. So far these methods have been taken over in their entirety from English routine methods, but where the question of continuity of records has no very great force, as in India, the best methods should be substituted. It can hardly be seriously contended that methods such as those of Wanklyn and Tidy are the best."

Dr. Gibson, in reply to certain criticisms by Major Clemesha on the elaborateness of his proposals, said his main idea in putting forward his paper was chiefly that of standardising the method of sending samples. His procedure, too, he did not consider so difficult as to be beyond the powers of any medical man.

Bacteriological examination of water.

The next paper (Volume II) presented to the Conference was the one prepared on the above subject by Military Assistant Surgeon E.C.R. Fox, Assistant to the Director, Pasteur Institute, Kasauli.

The following are extracts from the summary :—

" The functions of the bacteriologist in relation to the examination of water-supplies might be set down as—(1) confirming the views formed upon an inspection

of the locality of a source of water-supply; (2) furnishing an independent opinion on the characteristics of a proposed or already existing water-supply and (3) controlling the effectiveness of operations designed to free a water-supply from pathogenic bacteria. This is, I think, a comparatively modest and yet not unsound estimate of the bacteriologist's functions in relation to the subject. His method of examination may be described as—I. General.—the number of colonies which develop after insemination of a nutrient medium with measured quantities of the test water is computed (*a*) on gelatine, (*b*) on agar; II. Special.—(1) a determination is made of the smallest quantity of test water which still shows lactose fermenting and gas producing organisms in a nutrient medium containing bile salt; (2) the presence of typical B. Coli in minimal quantities is estimated. My work during the past nine months has consisted in an endeavour to erect one standard of comparison in the shape of a complete characterisation of a water of accepted purity and of definite type. The investigation in order to be complete will extend over a whole twelve months; but the results already obtained and the detail of the investigation may be of interest to this Conference. There are special advantages too which attach to an exhaustive investigation of this sort having reference to the laboratory water-supply. A sample from this supply may always be used alongside a test sample and so serve to some extent as an eliminant of variations due to accidental causes such as variations in composition of media, alterations in technique, and so on. My own investigation consists simply of a characterisation of a known good water—the Kasauli water—and not of a comparison. Thus it represents more a suggestion as to method than an idea carried to a conclusion. My opportunities for making comparisons were very limited."

Examination of samples of water.

Another paper (Volume) prepared by Military Assistant Surgeon E.C.R. Fox on "The examination of samples of water sent to a distant laboratory" was then introduced.

The paper describes a modification of Remlinger's method for preserving the original flora of water during its transit to a laboratory for bacteriological examination. Six per cent. of salt added to water preserves the bacteria at their original numbers for one hundred and twenty hours if agar be used for plating, but an addition of only 3 per cent. is more suitable when gelatine plates are employed.

Speech by Colonel Firth.

Colonel Firth then addressed the Conference as follows:—

"It was not my intention originally to speak on these papers, but as they refer to a question with which I have been intimately associated and in which I am still intensely interested, I should like to say a few words. I am sorry to say that one has been struck this morning with the curious want of progress which we have made in regard to this question of not only bacteriological standards for Madras but also as regards methods by which we are to transmit samples for examination. Now this question, as most of the technically-informed in this room know, is one which is not confined to India. It is a matter still under discussion in Europe. Of course one of the writers of the papers, namely Major Clemesha, has identified himself with some very notable work and I may say that it is work with which I am myself absolutely in sympathy although I am very much afraid that many people in India hardly realise what advance we have made and how much of that advance we owe to Major Clemesha. But still one cannot disguise the fact that even Major Clemesha's work has not carried us to finality and there is an enormous amount to be done. I wish however to make a suggestion to you. It is this, that so complex is this problem of water-supply and the various other details associated with such a subject that it is well worth serious consideration by the Department of Education to appoint a small commission from the personnel which you yourselves have at command, to go into the question of water-supply in India, making your terms of reference, framing them very broadly, in the first place to get the truth as to the fauna and flora of Indian water. This work is one which has so far been confined to the Madras presidency. We know absolutely nothing with regard to Bombay, very little in

regard to Bengal, and nothing of the Punjab. If you can see your way to bring in a commission which would be prepared to work for three years at least, in the first place to get the real hard facts as to the fauna and flora of Indian waters, then to concurrently be working with methods which are best adapted for Indian conditions for the bacteriological examination of such waters, and that would carry out investigations as to the best methods of conveying samples to and from laboratories. If you, Sir, could see your way to do that, I believe you would go a long way towards getting rid of many of the difficulties that we are all associated with. It would at once stop such discussions as we have had this morning where all are seeking after truth but none of the method or road by which we can get there. Therefore, Sir, in putting this, I am not voicing my own wish but the feeling of many others. There is a real need for such work, and if this country can go in advance of what is being done in England, it would be a credit to us. If the Department of Education—if the Government of India—could take this up—I don't mean at once—it would be very useful. You will have to have very technical workers, and give them three or four years to work it out. But I am quite convinced that the outcome of such work would be of inestimable value to science and anything but discreditable to India itself."

AFTERNOON'S PROCEEDINGS.

VISIT TO GUINDY.

SECTION A.

Vaccine lymph.

The delegates proceeded to the King Institute, Guindy, at 3 P.M. Section A proceeded to inspect the methods in use in the institute for the manufacture, storage and distribution of vaccine lymph. A paper (Volume III) entitled "Vaccine Lymph, its production, preparation and preservation." was read by Major Harvey of which the following is a summary:—

For the preparation of vaccine lymph both the cow-calf and the buffalo-calf have been used with success in India. Various other animals have been suggested at different times and the donkey has been put forward as a vaccinifer of special utility. The cow-calf and the buffalo-calf give equally good results, and age does not appear to be of importance except with reference to cost. Major Harvey recommends vaccinating the calf over a large area so as to increase the quantity of lymph obtained from each animal, but at the same time states there may be a danger in over-vaccinating. Temperature has an effect on the development of the vesicles and so have light and humidity. In the preparation of lymph various diluents are used, of which the best known are lanolin, vaselin, and glycerin. The first two exercise no deleterious effects on the vaccine virus, but likewise have little influence on the extraneous bacteria contained in the lymph. Glycerin kills off extraneous bacteria, but can only do so at a temperature above that of the cold storage chamber. At such temperature there is always the liability that the glycerin will, in the end, attack the vaccine virus too. A way out of the difficulty would seem to be in the use of chloroform which very rapidly purifies vaccine lymph of its bacteria. The lymph may then, after glycerination or lanolination, be placed at once in the cold storage and so receive the benefits of preservation under optimum conditions. Vaccine lymph when carried over from calf to calf is liable to degenerate, and degeneration is effected in a variety of ways—through human beings or by the use of an alternative vaccinifer of a different species. Whatever be the means adopted for regeneration, it is essential to make a distinction between stock and issue lymph. The former is the lymph used for vaccinating the animals, which produce the crude lymph. It must itself be always the best available and be always carefully preserved. For preservation a low temperature is essential and all institutes should be provided with the means for cold storage. As regards the issue of lymph the points to be attended to in addition to the cold storage are that it shall be despatched with protection as far as possible against the action of high temperature and that it shall be used up at the earliest possible moment after reaching its

destination. All vaccine lymph should be tested before issue. Vaccination operations should be hurried through so as to be all included within the cold weather seasons.

Demonstrations in Microbiology.

This was followed by some microscopical and practical demostrations in microbiology by Captain Patton, who exhibited an interesting method of breeding flies and another of breeding bugs. He also showed a plant which he said had a disease which was closely akin to *kala azar.* He further said that if the problem of how that plant had got *kala azar* was solved, the problem how man got the disease would also be practically solved. The only difference between the disease in the plant and man was a difference of form.

Dracontiasis.

The demonstrations were followed by a paper (Volume III) on "Dracontiasis," by Dr. Turkhud, of which the following is a summary :—

Guinea-worm is very prevalent in some districts in the Bombay presidency and is often a very serious cause of sickness. The disease is caused by Filaria Medinensis and has a distinct seasonal prevalence, but the life cycle of the worm is not completely known. The adult female on reaching the surface of the skin in a human being is already distended with embryos and discharges them into water whenever she comes into contact with it. The embryos swimming freely in water are eaten by cyclops which are common inhabitants of all wells and ponds. Within the cyclops the embryos undergo certain changes, and when infected cyclops are swallowed by human beings in drinking water, the gastric juice kills the cyclops and liberates the contained guinea-worm embryo. Their further life-history is not known, but about a year afterwards fully developed adult female worms make their appearance on the surface of some part of the human body, generally the legs. Whether it is possible for the larvæ to infect a human being without passing through an intermediate host is not known, but experiments are being carried out to ascertain this. As regards the infection of the cyclops it was generally believed that the larvæ gain entrance either by piercing its body with their sharp tails or by the way of the cyclops' intestine; the observations at Parel, however, showed that the larvæ are actually swallowed by the cyclops. A number of monkeys have been fed on cyclops infected for periods varying from 6 to 53 days. A monkey fed on cyclops carrying infection for ten days showed marked eosinophilia ; but a careful *postmortem* examination made three months afterwards showed no worms either in the internal organs or in the cellular tissue around the viscera. In the experiments at Parel, guinea-worm embryos were also found inside a Stegomyia larva, but whether they undergo any further development in this host is still to be ascertained.

SECTION B.

Experimental Sand and Mechanical filters.

While Section A. was engaged in carrying out this programme, Section B. was being shown the experimental sand and mechanical filters, King Institute, Guindy, Mr. Hutton giving an explanatory address (Volume IV) on the subject, of which the following is a summary :—

Sand filters.

"Analyses are made quarterly by the Director of the King Institute of the water supplied by the water-works in the Madras presidency. Owing to the unexplained variation in quality of filtered water from Sand filters, Major Clemesha, who was then acting as Sanitary Commissioner for Madras, reported that the type of Sand filter in use was unsuitable. He said that the depth of broken stone underlying the sand layers in the filters was too great and tended to the multiplication of bacteria in the post filtration passages. The type of Sand filter constructed by us is similar to that adopted in European practice. Our Sand filters have a depth of 2 feet broken stone with drainage tiles, 3 feet

of sand and above the sand a constant head of 3 feet of water. The side walls of the filter are raised above the maximum water level to a height of 1½ feet. The total depth of a Madras filter is therefore 9½ feet. Major Clemesha proposed that the filter should be constructed of the following depths:—one foot drainage layer, two feet 6 inches sand, two feet of water, six inches height of filter wall above water-level. This means a total depth of 6 feet and a saving in the cost of a Sand filter. It will be observed that the total depth of sand which can be removed by periodical scrapings in the case of the Madras filter is 1 foot and in Major Clemesha's proposal 6 inches, assuming in both cases that the minimum depth of sand in a Sand filter should be 2 feet. As it seemed impossible to prove which type of filter would give the best results in the high average temperature of Madras, I suggested to Government that two experimental Sand filters should be built at the King Institute, and that from the results of analyses it would be possible to determine which was the most suitable type. It is also proposed to continue the experiment with different depths of drainage layers, sand, graded and ungraded, and water, and to observe the increase or the decrease in number of bacteria which may follow. It will be noticed that arrangements have been made for the taking of samples of water at different depths in the Sand filter, and inspection windows have been provided so that observations of the working of the interior of the Sand filter may be carried out. The water entering and leaving the filter will be measured by meters. The works were only started in March and delay occurred in obtaining the pumping plant, which is required to pump water from the river Adyar adjoining the site, so that the installation cannot be shown to the delegates under working conditions, but it is hoped that some interesting results can be brought forward at the next Sanitary Conference."

Mechanical filters.

"The Government of Madras having ordered tests to be made of the suitability and action of Mechanical filters, it was proposed and approved that these tests should be carried out at the same time and place as the experiments with the Sand filter. At present the Mechanical filters that will be tested will be the Jewell and Patterson gravity filters and the Mather and Platt pressure filters, but it is expected that other types and systems of working may ultimately find a place in the experimental station."

Dr. Maitland Gibson then exhibited a box containing the apparatus mentioned in his lecture in the morning for the first testing of water at the places where samples were taken, thus avoiding all possible deterioration during transit to the testing station. He also exhibited an apparatus which he has devised for finding out the amount of nitrogen in water.

This was followed by an exhibition of the methods of disposing of the sewage at the institute.

EVENING'S PROCEEDINGS.

Sleeping Sickness.

In the evening a lecture (Volume III) was given at Guindy by Captain Mackie, on "Sleeping Sickness," at which many members of the Conference were present. The lecture was illustrated by lantern views. The following is a summary of the paper:—

The extension of the disease from West Africa across the Continent *viâ* the basin of the Congo into Uganda and thence into the Lower Soudan on the north and into German East Africa and Nyassaland in the south was traced. The disease spreads along the lines of human communication and might extend wherever the appropriate species of tse-tse fly existed. The name Sleeping Sickness applies only to the later and final stages of the disease. Persons may be infected for months and even years before somnolent symptoms appeared. The principal signs of the earlier stages are irregular fever with the occasional appearance of parasites in the blood and some other indefinite symptoms, but the easiest method of diagnosis in this stage is by the presence of enlarged glands in the neck. When these glands are punctured the specific parasites

(trypanosomes) could be demonstrated by miscroscopic examination. The cerebral stage comes on later and the patients become weak and tremulous and latterly exhibit symptoms of somnolence, and at the last the sleep passes into unconsciousness and finally into death.

The specific blood pararsite is Trypanosoma Gambiensi (Forde and Dutton), and the insect carrier is the tse-tse fly (Glossina Palpalis). This fly lives in a narrow zone or belt of country on the shores of forest clad lakes and the banks of rivers. It bites only during the day and attacks men and animals which penetrating its haunts. It produces a living larva at a birth which creeps away at once into the sandy loam near the water's edge and pupates—emerging in a short time as an adult fly. From about 5 per cent. to 10 per cent. of flies fed on an infected animal are capable of becoming infected and of transmitting Sleeping Sickness to healthy persons. These flies become infected on an average about 34 days after their infected feed. A fly remains infective as long as it lives, which is certainly over 100 days and it is so virulent that it may infect every fresh animal it bites. Probably no other biting insects can transmit Sleeping Sickness. As regards the Reservoir of Infection, the Royal Society Sleeping Sickness Commission of 1908-10 proved that cattle and particularly wild antelopes living on the lake shore and frequenting the fly zone were often infected with Sleeping Sickness without however showing any signs of the disease. This explained how the tse-tse flies in many places still remained infective in the absence of a human population. As long as infected antelopes are allowed near the fly areas, these areas remain infective to human beings and probably for an indefinite period. This shows that the suggestion of stamping out Sleeping Sickness by removing all human population is a hopeless one which would only render the last state of the country worse than the first.

The prevention of Sleeping Sickness must be carried out on one or more of the following lines, either by attacking the disease in men or by exterminating the tse-tse fly, or thirdly, by clearing out the game and other "reservoirs." At present the spread of the disease is being limited as far as possible by preventing the emigration of infected persons. Attempts to stamp out the tse-tse fly were quite impracticable in the present state of our knowledge except by clearing the small areas of the lake shore in the neighbourhood of landing places and villages. This method was successfully employed in many places, but was too expensive to be carried out on a large scale. Any attempt to destory all the game in fly belts and near the lake shore, though it would seem at first sight easy and efficacious, would probably not diminish the fly population but would drive them on to feed still more voraciously on any blood containing creatures near by. At any rate this and the jungle clearing method would only suffice "to create a desert and call it peace."

Fortunately for us none of the genus of tse-tse flies have ever been found in India, and it is improbable that they exist at all. As far as our present knowledge goes, the presence of tse-tse flies is a *sine qua non* in the transmission of Sleeping Sickness and so India would appear to be safe. However, as Surgeon-General Sir Pardey Lukis remarks it is wise to take all precautions, for we cannot be sure that the disease could not be spread by some other agency or even that tse-tse flies might not be introduced into India in some way.

FOURTH DAY, NOVEMBER 14.

MORNING'S PROCEEDINGS.

INSPECTION OF THE MADRAS CITY WATER WORKS.

Many members of the Conference paid a visit in the morning to the Red Hills where Mr. Madeley, Special Engineer, Corporation of Madras, read a paper (Volume IV) describing the Madras City water-supply. He pointed out the faults of the existing water-supply system and the effect of pumping on the health of the City, and then gave an interesting and detailed description of the intake tower, the screening chamber and roughing filter, and the entire water distribution system.

FORENOON'S PROCEEDINGS.

The Conference met at 10-30 A.M.

CHOLERA.

The epidemiology of cholera.

Captain W. C. Ross read his paper (Volume III) on the "Epidemiology of cholera," in the course of which he said:—

"In the order of known preventibility we have small-pox, cholera and plague. In the consideration of their prevalence and importance as causes of sickness and death we find them in order: cholera, small-pox, plague. A general consideration of the importance of applying preventive measures to these diseases on a large and general scale would lead one to deal with cholera and small-pox as the most important, and plague as a disease of secondary importance. Instead of this being the case, however, we find that small-pox receives regular and systematic attention, and plague is the absorbing subject to which excessive importance is attached, and upon which enormous effort is concentrated, whilst cholera is, like Cinderella, ignored and passed by.

The policy appears to me to be an erroneous one, the enormous economic importance of cholera and its persistent and increasing prevalence, combined with the admitted fact that it is largely preventible demand that it should receive more serious attention and point to the necessity for a systematic policy and a definite organisation for its prevention. The previous generation of medical officers in India had a large practical experience of the disease and elaborated an air-borne theory which survived and held the field until the occurrence of the historic epidemic at Hamburg-Altona, which led to a revision of existing ideas and the adoption of a water-borne theory on a hypothesis, which does not logically apply, and by a process of argument which is the reverse of logical, the fact was proved that cholera infection could be conveyed in water; but the fallacy was accepted that cholera is a water-borne disease, which is quite a different proposition. I maintain that nothing more was actually proved than the possibility of cholera being water-borne; nothing more could be proved from any such single example; and I maintain that the water-borne theory is based on the obsession of an illogical and erroneous idea which has been accepted and raised to the dignity of a theory of transmission, because of the clearness and completeness of proof in an isolated case and because of the great publicity which it received.

That there is a perennial and persistent source of cholera infection, that survives throughout the centuries under many various circumstances, and at all times, is indisputable, and, in order to arrive at a logical hypothesis with regard to the transmission of the disease, it is obviously necessary to begin with a definite and intelligible theory of its source. The obvious and satisfactory hypothesis is that it is disseminated by the "Human carrier," who may or may not have had the disease in a definite form, but who has the organism present and persistent in his intestinal tract for months and perhaps for years. This theory does not clash with the known fact, as to the feeble vitality of the organism outside the human body, but presents a complete and satisfactory explanation of all the known facts as to the outbreak and recurrence of the disease, and is intelligible and reasonable by analogy in

comparison with the proved theory of "human carriers" in enteric fever, which is in some respects a similar disease, and whose organism is also a delicate one, unable to live long under natural conditions outside the human host. The means of transmission are probably several, but ultimately resolve themselves into the introduction of infected material into the stomach. This may be done either in food or in water, but probably occurs commonly in food, both because food is more liable to being handled by others than is water, especially in this country, and because in many forms it presents a suitable medium for the multiplication of the vibrio, which ensures that the organism is present in sufficient numbers before being swallowed to produce an infection in some cases, in spite of the bactericidal powers of the stomach. The manner in which food or water becomes contaminated is comparatively easy to understand, when one considers the careless way in which the same water-supply is used for all purposes, and the negligent manner in which food-stuffs are exposed to the contact of flies, and handled by servants and shop-keepers, whose personal cleanliness is a negligible quantity, especially in the bacteriological sense.

The conditions favouring transmission may be summarised in an alliterative series as carriers, climate, crowds, contact, or contamination of food or water, and bad conservancy.

The importance of contact is probably small as compared with contamination of food or water by other means, and only assumes dimensions deserving consideration when the crowding is excessive, as happens at some of the great *melas* in India. In India, on the other hand, the climate is more generally favourable than otherwise, but it is interesting to observe the effect of the rigorous Punjab climate in reducing the prevalence of cholera as compared with the moist and warm climates of Bengal and Madras, where cholera is endemic, whilst in Behar and the Upper Provinces cholera is typically a seasonal disease, becoming prevalent in the warm weather when flies can breed freely, and dying out in the rigorous cold weather. As we cannot modify the climate, it is obviously more logical to devote our energies to the improvement of conservancy, and my whole argument leads up to this—that good conservancy is the Alpha and Omega of cholera prevention—as a practical measure, and on a large and general scale. Crowds and crowding we cannot prevent, and the "carrier" we shall always have with us, though we may hope to decrease his numbers. Water-supplies can, and should, be improved and made safer, but the essence of my argument is the necessity for breaking the chain of circumstances at its weakest and most accessible link, and fixing a great gap between man and contamination of his food, by means of good conservancy."

In introducing his paper Captain Ross said that he thought that an erroneous policy had been followed in that cholera received little preventive treatment and he thought the Conference might adopt a resolution on this point. Cholera was not invariably water-borne, and probably in this country, not generally. The important point in climate as a factor was that the conditions favouring an epidemic were essentially those necessary for a rapid reproduction of flies. The easiest link to deal with in the conditions favouring transmission was the fly, through improved conservancy.

Major Greig, Officer on special duty on the cholera enquiry, then introduced four papers (Volume III) on "An investigation on the occurrence of the cholera vibrio in the biliary passages," "An investigation of an epidemic of cholera convalescents and contacts in India," "An investigation of an epidemic of cholera caused by a 'carrier'," and "Observations on disinfection in cholera."

The occurrence of the cholera vibrio in the biliary passages.

In Major Greig's previous researches on enteric fever in India the occurrence of the bacillus typhosus in the bile was dealt with and its importance in relation to the "Carrier problem" was shown. In the present investigation it is demonstrated that the ordinarily accepted view that the cholera vibrio is merely an inhabitant of the intestine is incorrect. The cholera vibrio gains an access to the gall bladder in a number of cases and there finds conditions very favourable to its prolonged

life, *viz.*, a suitable medium to develop in and the absence of other competitors. This observation has a very important bearing on the prevention of cholera, because it explains many of the phenomena observed in connection with the epidemiology of that disease. An individual harbouring the cholera vibrio in the gall bladder will excrete it from time to time into the external world with the faeces and so give rise to the disease wherever opportunity offers. He is specially dangerous if he is travelling, as in the case of pilgrims in India. The cholera vibrio can live in the gall bladder without producing pathological lesions in that organ, but in some cases it does so. The occurrence of a toxic centre in the gall bladder may account for the very fatal sequelæ of cholera, *e.g.*, uræmia and pneumonia. The toxine will be absorbed from the gall bladder and can produce changes in the kidney and lungs. A record of observations made post mortem on 271 cases of cholera is given.

Major Greig, in introducing his papers on cholera said that they dealt with the different phases of the very important question of the carrier in cholera. In enteric fever the carrier question was of vital importance and in cholera it was equally important. In enteric fever it had been shown that when the bacillus typhosus gained access to the gall bladder it found there a very suitable medium for its growth. It did not there meet with other bacilli which might destroy it and thus lived for a longer period than in the intestine where other organisms flourished. The cholera vibrio had a similar relation to the bile. During the *Nutan Kalebar* festival at Puri this year he had had an opportunity of investigating 271 post mortem cases and he had found the cholera vibrio in the bile of about 83 of these. In the bile the cholera vibrio could live much longer than in the intestine, and consequently a person who recovered from an attack of cholera would harbour the vibrio for a pretty long time, and would be a carrier and would disseminate the virus of cholera in the course of his travels in the country. That aspect of the case was one of very great importance in the prevention of the disease. This had also some bearing on the serious complications which arose in connection with cholera, by which patients who had recovered from an accute attack, died at a later date from some complication, *e.g.*, uræmia. These complications are possibly brought about by the action on the organs of the cholera toxine absorbed from the gall bladder.

An investigation of cholera convalescents and contacts in India.

In this paper the bacteriological examination of cholera convalescents and healthy contacts is dealt with. The observations were made at Puri during the great festival of Jagannath held there in July 1912. In regard to the examination of the cholera convalescents it was found that 11 out of 30 were excreting the cholera vibrio at the date of discharge from hospital at Puri: these convalescents immediately leave for their homes, which are scattered all over India, a list of residences of convalescents is given in the paper. They are in a position, therefore, to disseminate cholera in many parts of India. The pilgrim centres are, therefore, of very great importance from the point of view of cholera prevention. It is further shown that perfectly healthy persons in contact with cholera patients may acquire the infection without showing any signs of the disease at all; hence in an epidemic of cholera there are the acute cases of the disease and secondly a large body of persons who are infected but show no signs of disease; the latter are by far the most dangerous and introduce great difficulties into the question of the prevention of cholera. Daily bacteriological examination of the stools of cholera convalescents was made for a prolonged period and it was shown that the cholera organism continued to be excreted for a considerable time in a certain percentage of cases and that the discharge was, as is the case in typhoid fever, very intermittent.

The question of dealing with convalescents and contacts is dealt with.

Major Greig, in introducing his second paper, said that during the recent outbreak of cholera at Puri, he had examined the stools of a large number of recovered patients and had found that 30 per cent of them were infected at the time they left the hospital. These men were potentially in a position to create

epidemics of cholera and he had demonstrated that they did produce these epidemics. One and half lakhs of pilgrims had arrived at Puri by train during the festival and the same number had left the place again for their homes. From this it would be seen that pilgrim centres were great exporting centres for cholera.

Another important point was the examination of contacts, *i.e.*, people who were perfectly healthy, showed no signs of disease whatever, but were in proximity to cases of cholera. He had found, in examining their stools, that they contained cholera vibrios. Thus there were a large number of perfectly healthy persons who were infected and who were a danger to other people. These people were more dangerous as carriers than the people who had the disease, for the appearance of the disease gave warning and due precautions could be taken, but the healthy carrier could only be detected by bacteriological examination.

An investigation of an epidemic of cholera caused by a 'carrier.'

In this paper it is clearly shown that the cholera convalescent who is excreting the cholera vibrio can cause an epidemic of cholera. The evidence in this case was very complete and was based on accurate scientific observations. A patient was discharged from the cholera hospital at Puri on 6th July 1912. He wandered about and was arrested and sent to jail on 23rd July 1912. A careful bacteriological examination of the stools of the man was made on the 28th July and he was found to be excreting cholera organisms in large numbers. This man caused a cholera epidemic in the jail at Puri, 17 cases and 5 deaths. The epidemic commenced a few days after the admission of the cholera convalescent. The epidemic was arrested by a very thorough and careful disinfection of all fresh night-soil in the jail. This investigation shows the danger of cholera "carriers" and the important part which they play in the dissemination of the cholera organism in India. The danger is greatly increased when the "carriers" travel throughout India as pilgrims do.

Observations on disinfection in cholera.

During the course of the investigation on cholera two opportunities offered for the study of disinfection in cholera on a large scale. The chief factors operating in the dissemination of cholera at Puri in July 1912 were (1) convalescents discharged while still infective, (2) contacts, that is, healthy persons harbouring the cholera organisms, and (3) flies—a number taken near collections of cholera cases were found infected with the cholera organism, and therefore in a position to transmit the disease. Water might be excluded as a causative factor.

The first observation was made in a jail into which the infection was brought by a "carrier" and 17 cases of cholera with five deaths resulted. All fresh night-soil was at once disinfected, the fluid covering the stool entirely. This was very important in order to destroy the cholera organisms and prevent flies getting infected. The epidemic ceased about three days after the commencement of the disinfecting operations. The second observation was made in the town of Puri which was severely infected with cholera in August 1912. The difficulties were much greater here, but in spite of these, the results were very favourable. The number of deaths from cholera was 39 on the 13th August. Disinfection with chlorinated lime of all fresh night-soil was commenced on 15th August. On the 22nd the deaths fell to nine, on the 24th to four and the epidemic ceased entirely at the end of August.

Major Greig, in introducing the above paper said that in Puri there were three factors which were chiefly at work in producing epidemics,—convalescents, cholera contacts and flies. The flies carried the germs on their legs and also in the alimentary tracts, and were in a position to infect food. A curious fact in connection with flies at Puri this year was that they seemed to come in very large numbers with the pilgrims and to disappear with them. It was possible to exclude water from these epidemics because there was no evidence of there being water-infection.

He had recommended the disinfecting of fresh night-soil in the jail to check the disease by destroying the organism and keeping off the flies, and the epidemic there had ceased. For use in the town he had advised the use of chlorinated lime, first because it was an active disinfectant, secondly because the smell kept flies away and thirdly it was cheap. The important factor was to keep flies away from the latrines, and in Puri they were thus able to deal with the epidemic, notwithstanding the defective nature of the latrines in the town.

Effect of pipe water-supplies on cholera.

Major Harriss in introducing his paper (Volume III) on "The effect of pipe water-supplies on the reduction of cholera in urban areas" said:—"I do not agree with Captain Ross. The provision of filtered water-supplies has had a very great effect on the reduction of cholera in urban areas. In table II it is seen to have considerably diminished the average mortality for the years under comparison. It has not, however, removed cholera completely and occasionally there has been a considerable rise above the rate 1 per mille. An enquiry has been made into the reasons why cholera has not been eliminated.

This inquiry may be classified under seven headings:—

(1) Are there other sources of water-supply such as rivers and wells and are these largely used?

(2) What is the class of people inhabiting the towns?

(3) Is the town a pilgrim centre?

(4) Is the pipe supply continuous or intermittent?

(5) Has the maximum mortality any relation to the prevalence of cholera in the district?

(6) Are there any other special circumstances bearing on the point?

(7) Have we sufficient data from which to draw conclusions?

The influence of flies in the spread of cholera was taken as a constant factor as these insects were in as large numbers before, as after, the advent of the water-supply and also because in fairs, for which we can provide an uncontaminated water-supply, cholera is rare and, if it occurs, is not widespread. I do not think the fly is sufficient to explain outbreaks as recorded in Lucknow in 1901 producing 4·50 deaths per mille. The enquiry has brought out little direct evidence except under the headings 1—3 and 6. The data to prove the contentions are insufficient and there are an enormous number of intercurrent factors to be dealt with under headings 1, 5 and 6 that have a bearing on the cholera incidence. As an example of a factor, I believe to be very little known, I may mention the strychnos potatorum. Mr. West, the Sanitary Engineer, while working on the question of silt in rivers, sent me some seeds of this plant and stated that they are largely used in riparian towns and villages as a means of precipitating the silt suspended in river waters. One bean well ground is sufficient to clarify 25 gallons and costs one pice for ten seeds. The seeds were sent to Dr. Hankin who reported as follows:—

'The seeds you sent me are of "strychnos potatorum." They are widely used in India for clarifying water. There is no reason for thinking that they contain any harmful ingredient. The Sanskrit name for them is "kataka." Manu says: "Though to name the fruit of the kataka purifies water, yet the water becomes not pure." My experiments tend to support Manu. Ganges water, contained 196 colonies per c.c. Forty-eight hours later it contained 823 colonies per c.c. Another sample of Ganges water treated with the ground-up seed contained at first 266 microbes and after 48 hours the number had risen to 20,000. Thus though the seeds, owing to the presence of a gelatinous mucilage, may act as a precipitant, no real purification occurs.'

If this water were infected with cholera, it is presumable though not yet proved that in a medium of this kind the vibrio would increase enormously. What influence this practice has on the spread or the virulence of cholera is at present unknown.

As the period after the advent of the water-supply has been too short to enable mathematical conclusions to be drawn from them, we will turn to common

sense factors. The fly as I said before is a factor and the destruction of its larvæ will be considered in another paper, but to my mind a far more important factor and one that has a greater influence on the production of the larger outbreaks is that the water in the pipe supplies becomes so warm in the heat of the day that it is unpalatable and recourse is had to the water of wells which are often subject to gross pollution. Under the Municipal Act we have no power over private wells. It is important that powers should be acquired sufficient to protect private wells from pollution, and also to prevent within them the growth of the Neocellia Stephensi which has been proved by Dr. Bentley to be one of the principal carriers of malaria in Bombay and which Major Graham found breeding in wells in Kosi and other towns of the United Provinces.

It seems most necessary therefore firstly to devise some method for the reduction of the heat in the pipe water supplied and to make the water palatable. This water is heated in the filter and in the storage reservoir, but is exposed to greater heat in the balancing tanks and supply pipes. Secondly after having made the water palatable, section 284 of the provisions similar to that in the Calcutta Municipal Act might be gradually enforced. This reads as follows. 'Whenever a supply of filtered water has been provided in any street, the 'Chairman may by written notice require the owner of any well situated in 'premises which are supplied from the mains to fill it up with suitable material"

The points for discussion are therefore—

(1) How far it is possible to reduce the heat of the water in our pipe supplies.

(2) The necessity for further powers for the protection of private wells in both sewered and unsewered towns."

Some practical points in dealing with epidemics of cholera.

Major Forbes-Knapton then presented his paper (Volume III) on the above subject. The following is a summary of the paper:—

" We are better acquainted with the nature and means of dissemination of cholera than with the other common infectious diseases, *viz.*, small-pox and plague, which visit us from time to time in epidemic form, hence we are better able to prevent its spread. We know that it is introduced into the system by the mouth either directly or indirectly through the medium of water, most commonly actually in drinking water, and occasionally owing to utensils used for cooking or the table or green vegetables having been washed in contaminated water. There is little doubt that insects, notably the common house fly, carry infection, by coming in contact with food after having settled on a cholera stool. In the Central Division, Bombay Presidency, when a case is reported to have occurred at a village, a list of questions is sent there to find out the conditions under which it appeared, together with a pamphlet in the vernacular entitled " Simple instructions to prevent the spread of cholera." This pamphlet explains that the disease is due to a micro-organism and is chiefly conveyed by drinking water, hence every effort should be made to protect the general supply from pollution. It advocates strict observance of personal cleanliness in those attending on the sick, and warns them of the virulently infective nature of the stools, strongly insisting on the necessity of burning them directly they are voided, in preference to burying them which does not destroy their infectivity. If the advice given in the pamphlet is carefully and efficiently carried out, experience shows that the disease disappears almost immediately, as lately demonstrated conclusively in the cases of Wai (Satara district), Sholapur town and Hadapsar (a village near Poona); but the difficulty is to get the people to follow the methods advocated. The distribution of medicines to those already suffering, does little or nothing to prevent the dissemination of the malady although acids given with a view to prophylaxis may assist in the matter. Cholera is a preventible disease and in process of time may become as uncommon in India as Typhus is in England, which although at one time extremely prevalent there, has almost entirely disappeared with the advance of sanitation. There has been a considerable decline in the incidence of cholera during the last twenty years, and we may confidently look forward to a much greater improvement in time to come. Large religious gatherings play a great part in spreading the complaint, but owing to the strict supervision now exercised in sanitary matters at many of the places where pilgrims congregate, their evil influence has been considerably lessened of late."

Major Forbes-Knapton, in introducing his paper said that in the accounts he had received from the Deputy Sanitary Commissioners in the presidency, he found that the methods adopted to suppress the disease were confined to the giving out of cholera medicines broadcast to the populace. This might do good to the individual, but had no advantage at all as a suppressive measure. He had also been informed that whenever the instructions embodied in the pamphlets issued were carefully carried out, the disease generally died out, but the usual thing was that these instructions were *not* carried out at all, and very little trouble was taken to make the populace do what was required of them. He thought cholera was not taken seriously enough in this country. A large amount of money and energy were spent on plague preventive measures which, if applied to cholera, would give very satisfactory results. He had that morning heard that in one district in the Madras presidency, in 1906, there were more deaths from cholera than there were in the whole of the Bombay presidency from plague in a year. This epidemic, he believed, only lasted three months.

Measures for dealing with cholera epidemics.

Captain Dunn next introduced a paper (Volume III) on "Proposed measures for dealing with cholera epidemics in the United Provinces," of which the following is a summary:—

Owing to the prevalence of cholera in the United Provinces, the Sanitary Department propose that the measures laid down in Government orders for dealing with epidemics in towns and rural areas should be amended. The chief amendment is to provide an organization to ensure the protection of the well water-supply in infected areas immediately on primary outbreaks being reported. The proposals suggest the use of the revenue staff of a district for this purpose, and that a sufficient supply of permanganate of potash be issued to the revenue staff to disinfect efficiently the wells in an infected area and to keep the wells so disinfected as long as cholera exists in the area. Other amendments are proposed to expedite reporting of primary outbreaks, to ensure the cleanliness of villages infected and to inform the people how to avoid infection.

Captain Dunn, in introducing his paper said :—

"This paper chiefly consists of proposed amendments to the rules for dealing with cholera epidemics, contained in the Manual of Government orders, United Provinces. As I have stated in the paper, I do not think that the orders enjoin a sufficiently active campaign against the spread of the disease, *especially at the commencement of the outbreak.* These paragraphs as they now stand are given in Appendix I. Appendices III and IV contain the amended orders.

As an example of the results obtained by applying these measures in a district, I have quoted those obtained in the Kheri district of the United Provinces. This shows that from the 1st week in May, when the proposed measures were taken, the cases fell from 95·1 per day to 13·3 per day in the third week, and to *nil* in June. This was notwithstanding a severe epidemic in the neighbouring foot hills of Nepal. In order to ascertain how much permanganate would be necessary to disinfect the average well, I carried out the experiment described in Appendix II, as the minimum amount of permanganate necessary had to be estimated in order to keep the cost of the scheme as low as possible. The results of the experiment were, that I was unable to recover living vibrios from water to which $\frac{1}{8}$ of a grain per gallon was added, after one hour.

In addition there is one point I have not touched in the paper, *viz.*, the cost of the proposed measures. I have calculated that in the 23 districts in which it is proposed to apply these measures, the average expenditure, for the last three years, on cholera epidemics has been Rs. 552. Of this Rs. 81 were spent on permanganate of potash, the rest being spent on such items as, salary of sub-assistant surgeons on cholera duty, travelling allowance of same, medicines and disinfectants, allowances to vaccinators, etc. In our proposals the average cost of stocking the 23 districts with permanganate would be Rs. 485. It is improbable that this sum would be spent in any one epidemic and by the use of this method we hope to do away with most of the other expenses. The results obtained in the Kheri district, given in this paper, justify this hope."

Bacteriology of the cholera vibrio.

Dr. Turner then read a paper (Volume III) on "The bacteriology of the cholera vibrio and its relation to the spread of the disease from the point of view of the Health Officer" of which the following is a summary.

The paper relates to experiments carried out during the recent outbreak of cholera in Bombay between June and August 1912, and the following conclusions are arrived at :—

(1) That the cholera vibrio is present in the excreta of persons dying or suffering from cholera.

(2) That the vibrio persists until some time after the patient is convalescent but not indefinitely.

(3) That in times of cholera epidemic the vibrio is found in waters, wells, tanks, vessels, etc., but that it does not retain its morphological and cultural characteristics or its virulence for any length of time.

(4) That an outbreak of cholera depends on—

(*a*) the strength and quantity of the dose of the virus received,

(*b*) the condition of the infected material which gains access to the intestine,

(*c*) the physical condition of the patient and his power of resistance,

(*d*) certain climatic conditions,

(*e*) the sanitary surroundings of the people, water, food, drainage and refuse disposal and the habits of the people.

(5) That when the vibrio leaves the infected person it loses its virulence in direct ratio to the time and conditions to which it is subjected.

From his investigations he had drawn these conclusions.

Dr. Turner, in introducing his paper said that this was one of the most important subjects the Conference had to deal with and he hoped the Conference would not disperse without making some definite statements of the ways and means that ought in future to be adopted to prevent it From time immemorial water had been recognised as the almost universal means of conveying the disease. The word "carrier" had been in the mouths of several speakers, and he would like to ask exactly what it signified. He also wished to know what the vibrio was, how it could be conveyed and what test could be relied on to judge of its presence. Major Greig had pointed out that in his investigations he had found the cholera vibrio in convalescents up to a certain stage, and Captain Gloster, who had been working in Bombay, would verify that statement.

The organism fortunately for the human race, is very faintly resistant to external influences; and it is for this reason, that when an outbreak occurs, prompt sanitary measures can control it.

How far and how long, a cholera vibrio can retain its virulence, externally to the human body, and how far the other organisms in water affect it, are still subjects for further investigation.

How the attenuated organism, found in water, can again regain its virulence when entering the body of its former host, is what we want to know.

Until then the practical sanitarian must consider all water containing a Comma vibrio, in the presence of a cholera outbreak, a danger, which by all the means in his power, should be attacked.

Without entering into the bacteriology of the innumerable cholera-like vibrios found in water and fæces, the presence of a Comma vibrio in water during a cholera epidemic is evidence of contamination from a case of cholera. It is, as already pointed out, held that infected water is always the cause of the spread of cholera, and that personal contact has little to do with the spread of the disease.

It is impossible to analyse the evidence collected during the outbreak in Bombay without coming to the conclusion that the personal element has a great deal to do with the spread of cholera in India. Without labouring too much on the habits and customs of the people, he was strongly of opinion that the spread of cholera was greatly due to direct infection from person to person by means of the discharges, contaminated hands, food, vessels, milk and water and flies.

The filthy privy baskets, over-flowing into open drains and thus soaking into sub-soil or storm-water drains, the position of the water service pipes and the common washing places are a constant danger at any time, but, in the presence of cholera, must contribute to a large extent to the circumstances favouring the spread of the disease.

For example, on visiting a person suffering from the disease, he or she will be surrounded with relatives and friends handling the patient. Many will be found occupying the same room, sleeping on the floor; they all use the same privy and washing place, eat from the same vessels; the water is stored in wooden, iron, earthenware, or other vessels, in the living room, cook-room or *nahani*, for days together. The friends and relatives will wash the dead body and take it to the burial ground or burning *ghat* and afterwards wash in the nearest tank or bathing place—without any disinfectant precautions.

Any one familiar with the homes of the poor can easily understand how cholera is thus spread.

He would like to lay stress on the point that it was the habits of the people that tended to the conveyance of cholera. In the outbreak in a hotel in Bombay a few weeks ago, a European visitor was attacked with cholera, and almost within the same hour a Goanese waiter contracted the disease; the same day there were nine further cases amongst the Goanese waiters. A bacteriological examination showed that the cholera vibrio existed in four out of the nine cases. It was easy to understand how the disease might be spread in a hotel or large family by the habits of the Indian servants. Captain W. C. Ross had stated that one reason why cholera in Europe had died out was the improvement in conservancy methods. In India you could not improve the conservancy of the individual by keeping the city clean.

Cholera vibrios.

Major Liston read a paper (Volume III) by Captain Gloster on "Vibrios isolated from various sources in Bombay during the recent outbreak of cholera" of which the following is a summary:—

During the recent outbreak of cholera in Bombay vibrios were isolated from the stools of 15 patients with symptoms of cholera. Eleven of these vibrios were agglutinated by cholera immune serum in dilutions of 1—1,000 or upwards, while four were not agglutinated in dilutions higher than 1—1,000. The four non-agglutinating vibrios were obtained on the 2nd, 3rd, 8th and 10th days respectively of the patient's illness. Two of these vibrios were agglutinated by the patient's serum in low dilutions, 1—10 and 1—20, while two were not agglutinated at all by the corresponding serums. The serums of two of the four patients agglutinated cholera bacilli in dilutions of 1—150 or upwards, that of one did not agglutinate at all and the fourth patient's serum gave an indefinite result. Non-agglutinating vibrios were also isolated from an old cholera stool, two wells, a tank and a sample of sewage. No constant differences were observed between the morphological or cultural characters of agglutinaters and the non-agglutinaters.

All the non-agglutinaters except one were pathogenic to guinea-pigs when given intra-peritoneally. Two non-agglutinaters and one aggultinater which were tested as regards their virulence for the pigeon gave positive results. All the agglutinaters failed to hæmolyse goat's red blood cells in 24 hours at 36° C., while all the non-agglutinaters which were tested produced complete or marked hæmolysis. On the other hand under the same conditions of experiment both the non-agglutinaters and agglutinaters which were tested hæmolysed human red blood cells. Three agglutinating vibrios tested for complement fixation gave a positive result, while with three non-agglutinaters the result of the test was negative. The identity or otherwise of the non-agglutinating vibrios isolated from various sources has not yet been determined by reciprocal serum tests.

The present observations furnish no evidence as to whether cholera-like vibrios exist in persons, water or sewage not recently exposed to cholera infection. The difference in hæmolytic properties between the agglutinating and non-agglutinating vibrios make it difficult to believe that the latter are true cholera vibrios which have lost their power of reacting with cholera serum.

Discussion.

In the general discussion that followed Major Greig explained that carrier meant a healthy person who harboured the cholera vibrio or the *bacillus typhosus* especially in his bile.

In reply to a question from Lieutenant-Colonel Browning-Smith, Major Greig said that observations had shown that convalescents remained infected for at least a year, probably longer, but he had not had the time to settle this point.

In answer to a question from Captain Justice as to the life of the cholera vibrio in the water of an ordinary well, Major Greig said he had made no experiments himself, but the experiments of others had shown that in water the life of the cholera vibrio was short.

Major Clemesha thought Captain Ross had rather allowed his mind to be tinged by his recent experiences at Puri. There was no doubt that cholera was spread by human contact, as pointed out by Dr. Turner, but the major portion of deaths from cholera arise from water. Fly and carrier epidemics were usually found in places where there were several European officers doing their best to keep cholera out. The jail and pilgrim epidemics in Puri were cases in point. Everything was done to keep prisoners as clean as possible, and yet an epidemic, started by flies, was going on in the jail. When the prisoners were taken into the garden and were given the same water, the epidemic disappeared. Because those epidemics had been fly-borne and carrier-borne, it did not follow that the old theory was largely wrong. Eighty per cent. of the death-rate in this country was probably due to bad water. In places where the water-supply is above suspicion, members of the same household frequently suffered from contact cases of cholera, but it was extraordinarily rare to get what would be termed a fulminating epidemic of cholera from this source. An epidemic brought about by the pipe water-supply becoming contaminated was absolutely unmistakable, though it was not so easily demonstrated in villages where there was more than one well. Cases occurred all over the city and broke out in very large numbers from the beginning. Captain Ross's remarks applied equally to enteric. Supposing the main factors in the rapid spread of the epidemic to be carriers and flies, surely cholera would resemble enteric very much more than it did! It was a mistake to underestimate water-borne cholera. Undoubtedly fly and carrier epidemics occurred, and they required very careful study and preventive measures proper to meet them; but at the same time water was the main factor in the extraordinary death-rate. He agreed with Captain Ross that good and adequate conservancy was necessary and meant happiness and good health to everybody, but it was by no means definitely proved that the best way of attacking cholera was to spend more money than was necessary upon conservancy. He thought it was still open to doubt whether control of carriers and measures of that kind may not lead to better results.

Dr. Bentley understood that Captain Ross had made a statement that cholera was not a seasonal disease. In the portion of Bengal of which he had experience, cholera occurred year after year at the end of the rainy season, October, November and December, and again in March, April and May, and ceased during the hot weather. It appeared to him that it was necessary to have this question of carriers in the endemic areas settled.

Rai Bahadur Kailas Chandra Bose said he had listened with considerable interest to the speakers on the subject of cholera. Captain Ross advised a regular crusade against flies. He differed from Captain Ross's view, and thought that there must first be cholera brought in either by contact or from some other source before the fly could be infected. The chances of flies getting contaminated from cholera stools were numerous. Cholera patients were quite incapable of going to retiring places, they soiled their clothes and sheets and their stools were recklessly thrown into the streets; flies got contaminated from these and carried the poison into the neighbouring houses. He would remark incidentally that the comma bacilli had been found occasionally in the saliva of healthy persons, and that this was no reason to infer that they would get cholera: certain conditions were necessary to make the field ready for the rapid growth of these bacilli. Endeavours were being made to arrest the progress of cholera by various methods. Major Greig's method of disinfecting the stools and thus immunising them and preventing the access of flies to them seemed the best. None of the speakers had mentioned preventive inoculation. Professor Haffkine, in co-operation with Dr. Simpson, late Health Officer at Calcutta, had tried it with good results, and this method ought to be encouraged. Defective conservancy was the source of many an evil and should be remedied. As regards carriers, he agreed with Major Greig that it was very difficult to say up to what period disease-producing germs may remain in the system. In Typhoid fever the

carriers may continue to carry the germ for a lengthy period, sometimes up to 14 years.

Captain Mackie had dealt with an epidemic in Farukhabad as a sanitarian, and had come to the conclusion that water played little or no part in the infection. There is a very large number of wells in Farukhabad, and yet cases were scattered all over the town and not confined to any one quarter. He thought Major Greig's papers would mark an epoch of a change in their ideas in relation to cholera and its dissemination. He thought that the opinion would gradually gain ground that the fly was the chief disseminator of cholera in this country.

Rai Bahadur Ganga Prasad Varma drew attention to the diminution of epidemics consequent on the introduction of water-works in the United Provinces.

Major Lalor deprecated any exaltation of the part played in the dissemination of cholera by flies at the expense of the part played in its dissemination by water. The fact that cholera generally—and this was particularly true of Burma—was especially prevalent in towns on the banks of the large rivers was sufficient to show the relative importance of water-borne cholera.

In reply to an enquiry from Captain Cragg as to how long the cholera vibrio lived in the gut of a fly and whether the kind of fly that becomes infected breeds in human excrement, Major Greig said he had not sufficient data, but thought it probable.

Dr. Master agreed with Captain Ross that conservancy played a very important part in the sanitation and preservation of health of a city.

He thought the less flies there were in the city the less chance there would be of the dissemination of disease. Attention should not be paid to water-supply to the exclusion of conservancy.

Captain Patton said the house fly of England did not exist in India. In the north of India there were two allied species. In Madras, the flies that breed in cowdung never go into houses. They are an entirely different kind of fly, are bloodsuckers not biters and have nothing to do with bazaars and houses. One undetermined species in Madras breeds round slaughter-houses in the contents of the carcases of goats. The house fly in Madras breeds entirely in nightsoil. He had been engaged in the study for about four years and would be glad to give his opinion if those who had opportunities of collecting flies would send him specimens.

MISCELLANEOUS PAPERS ON HYGIENE.

Popular errors in hygiene.

Captain W. C. Ross introduced his paper (Volume II) on "Three popular errors in hygiene" and drew attention to different paragraphs in it.

Conservancy in the tropics.

Dr. Newell, in introducing his paper (Volume II) "Conservancy in the tropics, an important work of the Health Department," said that as the health officer was expressly concerned in the prevention of disease, he thought that the control of conservancy should be under the health officer. He should not merely be an advising agent to the municipality, but an active agent in the prevention of disease.

It had now been proved that many tropical diseases are transmitted by insects which have their breeding places in rubbish, filth and stagnant water.

Infantile mortality.

Rai Bahadur Kailas Chandra Bose introduced his paper (Volume II) on "Infantile Mortality, its cause and prevention."

Major Lalor mentioned that in Burma they had a society, under the leadership of a distinguished Burmese lady, which held a number of baby shows and offered prizes. He ventured to say that the better looking after children was a matter in which more improvement might be expected from the initiative of the leaders of the people than from any Government enactment.

Epidemic fever in Calcutta.

Rai Bahadur Kailas Chandra Bose next introduced his paper (Volume III) on "The outbreak of epidemic fever in Calcutta."

Captain Dunn said that they had had an outbreak of this fever at Cawnpore

which was traced to importation from Calcutta. The cases they got there were typical Dengue fever as described by Major Rogers.

Major Clemesha said that there was good reason to suppose that the epidemic in Calcutta really came from Rangoon because the epidemic broke out first in the neighbourhood of Kidderpore where the shipping was.

AFTERNOON'S PROCEEDINGS.

SECTION A.

Section A re-assembled in the library at 2·30 P.M., under the presidency of Surgeon-General Sir Pardey Lukis, for the discussion of papers relating to fevers and various infectious diseases.

FEVERS AND INFECTIOUS DISEASES.

Dysentery.

Major Harvey, in introducing the paper (Volume III) on "Dysentery, problems and proposals," prepared by Captain Cunningham and himself, said :—

"A perusal of the literature of dysentery shows that in any enquiry into the subject the search for causation has been almost entirely directed to the detection of the bacillus described as the cause of dysentery and the amœbæ which is regarded as the cause of amœbic dysentery. This paper puts forward a plea for the widening of the basis of investigation of the disease by doing away with any assumption as to particularity of cause. We should go back once more to simpler criteria of causation in order better to control the work already done. The simplest basis to work upon is the clinical, and it should be our endeavour from this starting point to build up a structure which should not be so exposed to criticism as the present one. Dysentery would not be called bacilliary, simply on the discovery of bacilli described as causes of the disease nor as amœbic on the discovery of the amœbæ. Bacilliary dysentery would have to be proved not to be amœbic and amœbic not to be bacilliary and both not to be of other causation. Other bacilli than those accepted as dysenteric would be investigated as possible causes and other amœbæ likewise. The present high titre serum test for the differentiation of bacilli is a very fallacious one and represents an almost complete begging of the question of variability in the bacterial cause. With such serum we are bound to find, if present, a particular form of organism, that organism, namely, which produced the special properties in the serum. Better criteria of causation would be such as would particularly avoid this test. Criteria which to us seem to merit acceptance are—(1) the presence of clinical dysentery, (2) the determination of the most prevalent organism, (3) the existence of specific reaction of an unselected organism with the patient's own serum and (4) the reproduction of the disease or its symptoms in animals. The subject of the treatment of dysentery, curative and prophylactic, is largely bound up with the elucidation of the cause. There are many remedies in use for this disease and many effective. It would be worth while to investigate the results of treatment with different remedies when applied solely to the syndrome of dysentery apart from any consideration of the cause and to contrast these results with those obtained when the supposed cause *is* taken into account. In prophylactic and in curative treatment it is essential that proper controls be used if clear indication as to the usefulness of particular remedies is to be obtained. The range of effect of carriers and the influence of such sanitary measures as have an influence in contracting that range must especially be taken into account in connection with the reduction of incidence and mortality supposed to result from the use of prophylactic or therapeutic measures. In short, an investigation into this subject of treatment would try as far as possible to allow for the effect of that alteration of the *status quo* attendant upon concentration of attention upon the disease. This paper is intended to elicit information as to what bacteriologists would consider satisfactory lines of investigation into the cause, treatment and prophylaxis of dysentery."

Diarrhœa in Poona.

The above paper was followed by an "Interim report on the causes of diarrhœa in Poona," (Volume III) by Captain Morison, of which the following is a summary :—

Diarrhœa in Poona is prevalent in the monsoon months, and during the past season one-third of the cases had frankly dysenteric stools. The enquiry

was extended to all intestinal fluxes occurring during the monsoon. After examining the parts played by the mineral constituents of the drinking-water, by flagellates, by milk and by flies which breed in large numbers in the poudrette pits and in cowdung, the writer, making a general study of the bacterial flora of the stools, found that bacilli of the dysentery group were easily isolated by simple methods from nearly one-half of the cases whether the stools were purely diarrhœal or more or less dysenteric. The three chief bacilli found were Morgan's No. 1 Bacillus, and the Dysentery bacilli of Shiga and Flexner. Cases were instanced which showed that the direct infection of food by man might play a most important part in the spread of the disease. The investigation may be continued for another season and, if so, the relation of the various strains of the dysentery bacillus to the monsoon diarrhœa are to be studied by more special methods.

Captain Mackie suggested that attention should be paid to the presence of anaerobic organisms as well as to acrobes. He pointed out that at least one strict anaerobe, the *Bacillus Enteritidis Sporogenes*, was known to be a constant inhabitant of the human alimentary tract and he advocated further investigation into the matter. In an enquiry which he made into an outbreak of infantile diarrhœa in Bombay he found some organisms which gave sufficiently defined reactions to identify them with classical strains but many could not be so identified and some were anaerobes without pathogenic effects on guinea pigs and were therefore not *Bacillus Enteritidis Sporogenes*.

Major Lalor asked whether non-pathogenic organisms became pathogenic and *vice versâ*.

Major Harvey said that there were differences of opinion on this point. One school held that ordinary non-pathogenic amœbæ were capable of becoming pathogenic under certain conditions. As to whether amœbæ have any connection with dysentery or not had not yet been definitely settled.

The President said that this was one of the issues proposed to be investigated by the Scientific Advisory Board of the Indian Research Fund Association.

Major Greig said that in a large number of post-mortem cases they found that although there had been no history of dysentery, dysenteric lesions were found. The reason was that the lesion was very up in the large bowel. Cases of liver abscess were found post-mortem to have originated from a dysenteric lesion of the large bowel although the patient had no past history of dysentery in many cases. This showed that asking a patient whether he had dysentery was unreliable. Post-mortem the lesions of amœbic dysentery were quite characteristic and could be distinguished from those produced by the dysentery bacilli.

The President said that this difficulty was generally experienced. The distinction depended upon the height of the lesion above the rectum. He also thought that a large number of cases of so-called chronic dysentery were not dysentery cases at all, and that was one of the reasons why an inquiry under the auspices of the Indian Research Fund Association was necessary.

Tuberculosis.

Dr. Chandra Sekhar then gave his paper (Volume III) on "The prevention of tuberculosis in Madras," a summary of which is printed below :—

Tuberculosis is a disease widely prevalent in this country. It is a disease that is very much neglected in the early stages by the patients as well as by the medical men in this country. Medical men here have not yet realised the wide distribution of this disease. It is an easily curable disease if recognised early, but an absolutely hopeless and highly infectious complaint if diagnosed late, as is done at present. The measures necessary to prevent the spread of this disease are—(1) improvement of the general sanitation in towns as well as villages, (2) education of the masses in the elements of sanitation, (3) early diagnosis and treatment of the tuberculous cases and (4) establishment of consumption hospitals and sanatoria in various parts of this country.

Major Harvey, in introducing Lieutenant Fox's paper (Volume III) on "Tuberculosis and its relation to Public Health" said that the object of the paper was to show that sanatoria and hospitals were too expensive for the purpose of combating tuberculosis. Lieutenant Fox advocated educational methods and in particular the establishment of tuberculosis societies. He also recommended notification as a means of coping with the disease. The following are the suggestions made by Lieutenant Fox :—

(1) Notification ; (2) formation of Anti-Tuberculosis Societies and Bureaux for (*a*) education of the public (*b*) visitation of the tuberculous and collection of statistics ; (3) treatment of the tuberculous by (*a*) establishment of sanatoria as suited to India, (*b*) establishment of tuberculin dispensaries.

Discussion.

In the discussion that followed Dr. Newell said that there were three important stages to be considered in a discussion on tuberculosis. The first stage was the implantation of the disease in early childhood. To deal with this stage it was necessary to improve the ventilation of homes, schools, etc. Expensive measures were not needed. It would be sufficient if instead of the present unhealthy type of school which was so abundant, merely open sheds, with corrugated iron roofs were provided, at least for the present. The next stage was the early stage of infection, that is to say, when the disease was first recognised. Tuberculin had been proved by Dr. Wilkinson of London to be successful in many cases and he advocated tuberculin dispensaries under the control of Health Officers. The country was not ripe for sanatoria. It was the homes of the people that should be tackled in the first instance. As regards notification he thought this was essential. He did not agree with the building of sanatoria in the plains as coolness was essential for success.

Major Graham stated that, in the United Provinces, there was a sanatorium in the Kumaon hills. It was so popular that many admissions had to be refused. In the Lucknow Medical College there was an anti-tuberculosis dispensary on a small scale. The wholesale introduction of dispensaries in the present state of knowledge would, he considered, be very wrong as very little supervision would at present be possible in such institutions.

Dr. Rutherford said that a dispensary and a sanatorium were being started in Ceylon. Notification was not compulsory in Ceylon, except in Colombo.

Rai Bahadur Kailas Chandra Bose endorsed the major portion of Dr. Chandra Sekhar's views. He regretted, however, that there was not the amount of call from the public that there should be for these sanatoria and dispensaries. Moreover in Calcutta they found that the public were not so ready as anticipated to avail themselves of the public and private dispensaries provided there. However, he thought it a necessity that separate hospitals and sanatoria should be provided for consumptive patients, owing to the great risks run by other patients, when tuberculosis patients were present.

Dr. Bentley stated that his recent experience in a Bengal district had shown that there was a very large amount of phthisis, probably amounting to between 5 and 10 per cent. of the total mortality in that particular area. He thought that many of the cases in towns had their origin in the mofussil, and this made it difficult to deal with the disease at an early stage. The question, therefore, was a very difficult one, and he doubted whether the introduction of sanatoria would be of very much utility. Dr. Newell agreed with Dr. Bentley as regards the prevalence of tuberculosis in rural areas ; he considered that there was very little tuberculosis in meat. The dung of cattle, however, could contain tubercle bacilli without the cattle themselves having tuberculosis and he thought that the use of this in houses and elsewhere was a fruitful cause of the disease.

Malta fever.

Major Harvey then read a paper (Volume III) by Captains Paterson and Brown upon "Reflections and proposals resulting from an enquiry into epidemics of Malta fever occurring in the 37th Lancers and 10th Lancers in India." In introducing the paper, Major Harvey said :—

"The paper deals with the account of three distinct, though small, epidemics of Malta fever. In two of these the mortality was by no means small. It is

some time now since a special commission worked out the epidemiology of Malta fever and pointed out the obvious means to prevent the occurrence of Malta fever in the human subject. These measures have, for various reasons, not been very widely applied in India. Indeed it is only now that we are beginning to realise the degree of prevalence of the disease in India. This disease presents in its epidemiology much the same features as many other diseases, such as typhoid fever, plague, cholera and sleeping sickness. It depends for its continuance upon carriers, or reservoirs, as we heard them called in the interesting lecture of yesterday. What we want to know in India is (1) more about the real prevalence and form of the disease in human beings; (2) whether the goat is the only carrier of importance in this country and how the goat itself contracts infection; (3) the degree of prevalence of carriage amongst animals proved to be carriers and (4) satisfactory means of preventing the disease. I do not think the authors of the paper wish to take up any alarmist standpoint, but they are evidently—so far as their investigations have gone—inclined to believe that other carriers than the goat may have to be taken into account. 'We may'—they say—'not be altogther correct in supposing that the drinking of cow's milk is harmless as a vehicle for the transmission of the Malta fever germ.' It is essential then that we should have proper tests to safeguard us against such possibilities. These tests would be mainly applied to the detection of the carrier, but I would draw your attention to a very simple test described in detail by the authors for the differentiation of boiled from unboiled milk It is the Ortol test. Such a test may obviously be a very useful one. It is capable likewise of indicating not merely that milk has been boiled but, within limits, the degree of temperature, short of boiling, to which it may have been subjected. The authors finally point out that inquiry into the subject of this disease should be directed not only to preventive measures but to remedial. The disease has a certain mortality, but apart from any such issue as death, it is a cause of production of great inefficiency in the attacked owing to its often prolonged course and debilitating effect."

Captain Mackie said that the views of Captains Paterson and Brown tallied with his own. It would be found that Malta fever was not easily recognised. As an instance he recalled his experience in Uganda where there was an epidemic of disease of unknown causation in a distant part of the interior. Two capable officers who had previously been sent to investigate the disease came to divergent opinions, one reporting it as *beri beri* and the other as *kala azar*. When the epidemic was investigated by the sleeping sickness commission under Sir David Bruce it was proved to be Malta fever and the local goats were found to be infective with Micrococcus Melitensis. It was not known how the disease had cropped up over three thousand miles from the Mediterranean shores. He added that when a civil surgeon in the United Provinces he saw certain sequelae, particularly joint troubles and secondary muscular atrophy from disuse, which was generally attributed to some form of neuritis but which he suggested might be an after result of Melitensis septicæmia."

Dr. Newell said that in the Punjab Malta fever definitely existed. About 4 per cent. of the goats examined in the course of an investigation were found to be infected. Goats were often kept inside houses during the cold weather, and as it was probable that the urine of these animals was infected, it was possible that transmission of the disease was due to insects either biting the goats or carrying the infection from the urine.

Dr. Bentley with reference to a statement of Captain Mackie said that *kala-azar* did, in fact, often resemble Malta fever. For instance, an undulant fever was seen in many cases of *kala-azar*.

Major Lalor invited attention to a peculiar form of fever in Burma. This type of fever was distinctly undulant and heavy perspiration and other such symptoms suggested Malta fever.

Dr. Korke said that in 56 charts of cases of *kala-azar* which he had seen in Madras he had not discovered any that showed symptoms of undulant fever.

Dr. Bentley in reply said that both perspiration and undulant fever were seen in many cases of *kala-azar*.

Enteric fever in India.

Major Greig then read his paper (Volume III) on "*Enteric fever in India," of which the following is a summary :—

In this paper a narrative account of the history of the enteric fever research in India (1906-1908) and the results of the working in actual practice of its recommendations is given. Major Greig was deputed to Germany in 1905 to study the methods employed there in the scientific investigation of enteric fever. On his return to India in 1906 a committee was formed and investigated the subject on the lines laid down in a report by Major Greig on the German methods. This investigation lasted two years, and for the first time in India the presence of the "Chronic Enteric carrier" was demonstrated and also that the term "Enteric fever" really included other infections than that caused by B. typhosus, *viz.*, B. paratyphosus A. and B. The recommendations were given effect to by the establishment of two Enteric fever convalescents depôts, one at Naini Tal and the other at Wellington and to these all convalescents enterics from the British troops in India are sent. These have now been working for some years and the results are very gratifying. In 1907, before the depôts started, the number of enteric cases amongst the British troops was 910, the deaths 192, in 1911 the number of enteric cases was 274 and the deaths 24. The military medical authorities consider that the striking reduction is mainly due to our present-day system of segregating convalescents which was carried out on the recommendation of the Enteric Research Committee.

Captain White asked Major Greig how they had solved the difficulty of dealing with a man who continued to excrete bacilli for months. He asked what the army did in such chronic cases.

Major Greig said it was a very difficult problem. They could not keep them under observation all their lives and at the same time they could not keep them in the army as a danger to other men. The problem had yet to be solved.

---

* The following are the names of those who carried out the original investigation :—

(1) Lieutenant-Colonel Sir David Semple, Kt., R.A.M.C. (retired).
(2) Major E. D. W. Greig, I.M.S.
(3) Lieutenant-Colonel Wyville Thomson, I.M.S.
(4) Captain D. Harvey, R.A.M.C.
(5) Captain F. N. White, I.M.S.
(6) Captain E. C. Hodgson, I.M.S.
(7) Civil Assistant Surgeon Paras Ram.

SECTION B.

SEWAGE AND REFUSE DISPOSAL.

Poona experimental sewage installation.

Major Hutchinson introduced his paper (Volume II) on the results of the Poona experimental sewage installation, and made the following observations :—

" The working of this installation permitted observations on two points of some practical importance in conservancy—(1) the volume of excrement per individual and (2) the nuisance from latrines. Experiment proved that one gallon of material from a latrine (inclusive of ablution water) represents the output of 3·7 individuals. This is a figure close to that given by Captain Gourlay in his valuable report issued to the Government of Eastern Bengal and Assam. The ordinary latrine is associated with a swarm of flies and smell—over 600 visits per diem were paid to the latrines under observation: the pans after washing were wiped with rag soaked in crude oil. The result was fairly satisfactory, although the nuisance was not eliminated. It may be remembered, however, that in the absence of a more perfectly designed latrine the nuisance can be kept by the use of crude oil within reasonable limits. Unfortunately the sweepers unless efficiently supervised will not clean and oil the pans. The Royal Commissioners on Sewage Disposal lay down three main objects in septic treatment—(1) sedimentation, (2) digestion of sludge and (3) equalisation of strength as regards sewage. The digestion of sludge is accompanied by evolution of gas—gas bubbles in their ascent raise particles of sludge, some of which leave the septic tank in the effluent. This experience is not confined to India, but is noticed during the summer months in England. In Poona, it has been found that the evolution of gas at certain periods is very violent. These periods occur daily but at very irregular intervals and usually are of short duration. Analyses of samples of septic liquor taken during ebullition and quiescence show an enormous variation in strength; for instance, the figures for suspended solids during gas evolution may amount to 220 parts per 100,000 during quiescence to 7 only. It is very evident that the active evolution of gas interferes with the first and third objects of septic treatment—sedimentation and equalisation of strength of the sewage. This increase in the quantity of suspended matter in the septic effluent is from the point of view of subsequent purification perhaps the most important disadvantage in septic action. If the septic liquor is to be treated on an open soil free from clay, in a site far from habitation the suspended matter may be neglected, but if the soil is unsuitable, or artificial filtration is necessary, the advisability of removing the suspended solids must be considered. The number of gallons of septic liquor, with which a cube yard of material arranged as a straining filter will deal, depends among other factors on the amount of matter in suspension. It may prove sound finance to increase by three or four fold or more the volume of septic liquor with which a unit of filtering material will deal by removing the suspended matter from the septic liquor. Experiments on these lines have been conducted, first by the use of mechanical contrivances in the septic tank itself, such as colloiders and the attachment of a metal flange to the end of the scum board. The results have been disappointing. Secondly, by the interposition between the septic tank and filter of secondary tanks. The hydrolytic tank is of limited applicability in Western India owing to the frequent cleaning required, certainly twice a week and possibly more often in the hot weather. The macerating tank, which is perhaps better named straining tank, has given excellent results in removing suspended matter, in increasing the volume of liquor per unit of filtering material, and in prolonging the life of the filter. There is one disadvantage attached to the tank the increased production of H_2S. Sulphuretted hydrogen in a septic liquor is a disadvantage not only from its smell, but because it causes an increase in the filtering area required. The ideal is a secondary tank which will remove the suspended solids, and at the same time destroy H_2S. Unfortunately I have not had the opportunity of conducting experiments on these lines but I would like to draw the attention of the members of the Conference to the experiments with lime precipitation subsequent to septic treatment conducted at Dorking for the

Royal Commission. By lime the suspended solids are precipitated, sulphides are destroyed, the alkalinity is increased—in fact a liquor is produced free from objectionable smell and easy of treatment on a streaming filter. The disadvantage is an increase in the volume of sludge to be dealt with, and the necessity for supervision. Secondary lime precipitation should be applicable in small installations in the neighbourhood of habitations. The question of the period of rest in the tank is intimately associated with the production of sulphides—when H_2S. is formed a prolonged rest in the tank is not advisable. The evolution of sulphuretted hydrogen is of some importance in the case of an open tank, for it was found that the septic liquor in the absence of this gas (a mere trace proved an efficient larvicide) provided a suitable breeding ground for mosquitos. It has been stated that septic treatment is not possible in the plains of India on account of the high air temperature. The heat in Poona during the past hot weather was exceptional. The temperature of the septic liquor was taken in the early morning, and during the heat of the day. The maximum temperature recorded in the septic fluid was 92°F. The daily variation between the maximum and minimum temperatures was small, only 1°F. High temperature is a disadvantage in that it favours gas evolution, and so interferes with settlement. As the raised suspended matter can be removed by suitable secondary tanks, high temperature need not necessarily be a contra-indication to septic treatment—it is only a disadvantage."

Mr. Madeley advocated the use of a hydrolytic tank form of and mentioned an installation in which it was working well.

Mr. Cox also advocated the use of the hydrolytic form of tank to effect separation of solids and mentioned that the success of the tank depended upon the arrangements for the frequent removal of deposited matter.

Major Clemesha asked if Major Hutchinson seriously advocated the use of secondary lime precipitation tanks.

Major Hutchinson in reply said that hydrolytic tanks were very successful if the suspended solids were at once removed. He did seriously advocate the use of secondary lime precipitation tanks.

Percolating filters.

Another paper (Volume II) by Major Hutchinson on "Percolating filters" was then taken as read.

Colombo drainage scheme and sewage treatment.

Mr. Cox next introduced his "Note on the Colombo drainage scheme and sewage treatment works" (Volume II) and the following is a brief summary of the paper :—

A brief account is given of the drainage scheme for the city of Colombo with details of the first instalment of the sewage treatment plant and a description of the new water carriage latrines erected in the city. The present treatment plant is designed to deal with the sewage from a population of 60,000 and has been in operation for two years. Some observations of the treatment process are recorded and comparative analyses of the sewage and effluents given.

Mr. Madeley inquired about the cost of the Colombo scheme and desired a detailed statement of cost, as actuals were more desirable than estimates. Information was wanted as to form of separation. How does sewage get to purification works? Long pumping mains, he considered, were highly undesirable in Madras.

Aerobic beds.—How fine is the material on the top layer? House connections were not possible for all houses in an Indian city at present. Where does effluent from bacteria beds discharge? Are humus tanks necessary?

Septic tanks.—In Madras the sewage is septicised by the time it arrives at the farm. How is night-soil disposed of?

He thought Indian communities must not try and do things too cheaply. The Conference should determine what was just good enough.

Mr. Cox said that there were at present only short pumping mains, those between the treatment works pumping station and the septic and storm tanks. Storm water in the sewers in excess of six times the dry weather flow would be separated at the specially designed separator manholes. The surface material on the aerobic beds was about $\frac{3}{4}$ inch size. The final effluent discharges into the Kelani river in close proximity to the works. The night-soil from unconnected premises was entrenched at the Conservency Depôt but sanction had been obtained for one experimental tipping depôt discharging into the sewers.

Night-soil disposal and associated fly breeding.

Major Harriss next introduced his paper (Volume II) on "Night-soil disposal and associated fly breeding." In introducing the same, he said—

"The more frequently trenches are visited the more one is confirmed in the opinion that they are a very prolific source of fly production. And as I have shown with a very rough experiment, a moderate estimate of the fly production in 8 999 cubic feet is 24 million flies a month. The various methods of night-soil disposal have been shortly discussed as to their advantages and disadvantages from a sanitary and monetary point of view. I omitted to mention that with small incinerators the objection to smell has to be obviated by the introduction of grass into a special chamber in or under the chimney. Meagher has shown that rubbish is a valuable manure and enriches the soil for eight years. It is a pity therefore to burn it in towns where there is a demand for it. The ash is also of some manurial value. I have also not mentioned the method of mounding night-soil by mixing it with earth by hand. This system is employed in Burma, but during the process of mixing flies swarm. Another method that has been recommended but has never been carried out in this country is the erection of a set of cells 10 or 12 feet high approached by a ramp. The walls are fitted with fly-proof apparatus. Night-soil and rubbish are deposited in alternate layers. As the rubbish is largely surface sweepings, it contains great numbers of nitrifying organisms. One cell is filled within seven days and is then closed by a fly-proof cover. The contents are sold to cultivators as required after a period of three months. This is stated to produce most excellent manure. The cost of construction of these cells would, I am afraid, prove prohibitive. Municipalities do not like to lose their income by the sale of rubbish and night-soil, and the cultivators require these valuable manures. The sanitarian has, I think, too great a tendency to look at everything through his own eyes and to forget the economic factor. The country is asked to produce crops continually and even cow-dung is not returned to the soil but is used up in fires for cooking. Everything is taken out of the soil and nothing returned to it with the consequence that it becomes yearly poorer. One reason the cultivator prefers crude night-soil is that the moisture is more easily retained by the soil treated with crude excreta an important point where there is no irrigation or where only lift irrigation is available. Although a good income is obtained by the methods in use, they are nearly all open to the objection of encouraging fly-breeding. The Thornhill system on the other hand is excellent, but the cost of treating is very large. Howard in his book on the fly mentions chloride of lime 1 lb. to 8 quarts of manure as an excellent maggot-killer. Also 1 pint of kerosine to 8 quarts of horse manure or 2 lbs. of iron sulphate. These measures are, I think, quite inapplicable to India as they are far too expensive and moreover chloride of lime will not keep long. In view of the difficulty of the disposal of night-soil cheaply and yet with the elimination of fly-breeding, the following points require discussion;—(1) what is the best method of excreta disposal in towns to prevent fly-breeding (*a*) in night-soil in a colloid condition and (*b*) in a solid condition from private latrines; taking into consideration firstly the question of probable expense, secondly income to the municipality, thirdly the possibility or impossibility of irrigation of trenched land? (2) Howard has shown that flies can come to the surface through 48 inches of sand. How can we in these circumstances best dispose of night-soil to prevent fly-breeding at fairs taking into consideration the question of (*a*) expense, (*b*) fluctuating population which may reach two millions a day?"

Disposal of rubbish in Madras.

Dr. MacDonald next introduced his paper (Volume II) on "The disposal of rubbish by means of small incinerators in the City of Madras." The following is a brief summary of his paper:—

After discussing shortly and dismissing other methods of rubbish disposal incineration is gone into fully as "by far the safest and in most cases the cheapest way of getting rid of rubbish." Previous partial failures of the application of western methods are attributed to (1) the less combustible nature of the rubbish to be dealt with, (2) the excess of moisture in it especially during the monsoon and (3) a faulty separation of the combustibles from the incombustibles.

The conditions obtaining in Madras are then described—rainfall—type of incinerators used—their distribution throughout the city—the method of working them and the financial aspect of the subject. The advantages of disposal of rubbish by small incinerators are given as—(*a*) it is a sanitary disposal, (*b*) tanks and insanitary low lands can be reclaimed, (*c*) cartage charges are reduced and (*d*) small incinerators are much cheaper than a large one for the same amount of disposal. A warning is given that night-soil must not be mixed with the rubbish or nuisance arises.

In introducing his paper Dr. MacDonald remarked that Madras was an aggregation of villages, very different from Bombay and Calcutta, where his system wouldn't apply. Incinerators save carriage. He did not press his own special type of incinerator: he was merely contending that the system of scattered small incinerators is sanitary, and he hoped the practice would be extended to other provinces. Dampness was a disadvantage in Madras where the rainfall averaged about 40 or 50 inches. Conservancy work was suspended by really heavy rain. When sun drying is not possible the spraying of crude Burma oil is practised. The time of burning has to be regulated by the presence or absence of sun. The only fuel used is the spraying of crude oil.

Dr. Newell remarked that he had visited the Madras incinerators and considered them a financial saving and useful in filling up low-lying land. No one could dispute the value of the system though local conditions must determine its adoption or not. In the Punjab, and no other parts of India, many different types of incinerators had been used with varying degrees of success and there was one type in which the urine was boiled besides burning the night-soil. In cantonments where old stable bedding was available a certain degree of success was got, but where night-soil was mixed with rubbish at other places the incinerator did not work well. The incinerator in Madras was entirely one for the disposal of rubbish, and he was of the opinion that if night-soil was mixed with the rubbish the incinerator would not work so well. The system introduced into Madras had done a great deal of good.

Major Williams enquired if incinerators gave rise to nuisance or complaints.

Dr. MacDonald said that at first nuisance was very great. Care must be taken in the selection of sites. The incinerators must never be near residential quarters—he could not say what should be the nearest distance—much depended on the prevailing winds. In Madras the complaints had never been very wide—probably not more than 12 in all in a population of over 500,000.

Major Williams said that they had tried them in Burma, but the Burmese would not allow the use of them, as they objected to the smell of the burning. What they worked out was a cheap form of incinerator—double grating with a good draft fuel on lower grating and material to be placed on top. Slow combustion was necessary for stable litter.

Dr. Nair remarked that the use of incinerators depended much on what was burned in them. There was a distinct prejudice among the people against the burning of night-soil. The success of incinerators depended very much on the separation of night-soil from rubbish. He was of opinion that people would accept the incinerators even if there was a slight nuisance, as the old dumping grounds caused infinitely greater nuisance.

Dr. Master asked how long the material to be burned was stored before it was put into the incinerators.

Dr. MacDonald replied that the maximum time was 25 hours. There arose no question of congestion of rubbish in the dry season. In the dry weather the bulk was finished before 12 noon, and there was no stacking.

Mr. Williams asked if any attempt had been made to estimate the temperature of gases in these incinerators. He thought that a temperature of 2,000° F. was required to burn the ordinary Indian refuse to an innocuous residue without creating any nuisance. The smell of slow combustion may be carrried half a mile or more.

Colonel Wilkinson remarked that incinerators might prove a most economical method of dealing with night-soil. Combustion should be exceedingly slow if nuisance from the smell is to be minimized. He instanced the boiling of milk over a slow fire and contrasted it with the burning of milk and the smell so produced. He suggested gradation in incinerators with night-soil on top. It is sometimes said that it is morally wrong to deprive soil of refuse and night-soil. But it was only a matter of business. Cultivators could not expect that the town should provide them manure at the cost of the municipality. The municipality saved by incinerators the expenses on carriage. If incinerators were working properly there would be no necessity for carriage at all. In the Punjab it can be within a few yards of the house. The incinerator was possibly the best method of dealing with night-soil in the absence of sewers.

Major Williams said that it was difficult to incinerate night-soil without creating nuisance. In jails the whole excreta are consumed with great economy. By slow combustion the nuisance was reduced—indeed the smell was just that of burning organic matter.

Colonel Wilkinson thought that smell depended on fuel and the rate of combustion.

In the Punjab they had sweepings, leaves, grass, etc. He pointed out that incineration led to careful sweeping as the fuel must be found.

Major Williams said that the fuel in Burma was principally the husk of rice. Major Clemesha wished to draw attention to the fact that the success of the system depended on the fuel obtainable. English rubbish for instance would not burn. In Bengal the rubbish contains much moisture and is absolutely incombustible, so it cannot be used as fuel for burning night-soil.

Mr. Cox stated that the question depended on the possibility of obtaining an efficient rubbish incinerator of small size.

Captain W. C. Ross remarked that the incineration of rubbish was very easy and the incineration of night-soil was very difficult. They should not be discussed together.

Captain Justice then drew out a plan of an incinerator and explained the process.

The sullage farm at Agra.

Major Harriss next introduced his paper (Volume II) on "The sullage farm at Agra."

He said that the paper was written with a view to show that sullage farms when properly conducted were most paying concerns and could be used as a useful adjunct to schemes for the improvement of the milk supply by providing fodder at all seasons of the year.

In choosing a site for a farm the character of the land is of the utmost importance. The soil must be a porous sand or sandy loam. The land on which the farm is situated should be municipal property. If this land is not municipal property the landowners or tenants refuse to take the sullage at certain seasons of the year, and the whole has to be discharged into rivers. At the Gulalahar farm at Lucknow the land is the property of a Raja from whose tenants we have been unable to collect any revenue for the sullage given to them. Thus from a monetary point of view it is also of advantage for the land to be municipal property.

The management of the farm should be in the hands of the Sanitary and Agricultural Departments. The former attend to the working of the farm on sanitary lines and the latter advises on the character of the crops to be grown at various seasons of the year. They were just adopting this method at the Gulalahar and Wingfield Park sullage farms at Lucknow. A new area is being taken up of about 150 to 200 acres, and the sullage pumped across the Gumti river on to this area. The Agricultural Department will experiment on this land with the grasses most suitable for fodder crops which will in all probability be sold to *gwalas* in connection with the model byre-system for milch kine.

Though it has been proved that the proximity of sullage farms is not detrimental to health, he personally preferred that it should be situated some little distance from the inhabited area, as otherwise constant complaints of nuisance from smell are received. It is largely for this reason that the Wingfield Park farm, which is only separated from Butlerganj, the new extension of Civil Lines in Lucknow, by the Butler Road, will be removed across the river as soon as funds permit. If the expenses of land acquisition are to be low, the land chosen for a farm should be, as above stated, sandy loam of little or no value. Mr. Meagher in his book, "The Farm Manual for India," states that two or more floodings in one year with sewage or sullage are sufficient to convert the most barren into rich arable land fit for any kind of grass or vegetable. From the experiences gained at Agra absolutely worthless land now brings in an income of Rs. 73 a bigha. The crops grown on this land are sugarcane, tobacco, and winter cabbage. The sugarcane crop yields 600 maunds per acre. From their interesting visit to the Madras sewage farm they were encouraged to adopt more generally this method of disposal of a fluid of great manurial value.

Mr. Madeley enquired whether the neighbourhood of sullage farms was healthy.

Captain W. C. Ross reported that malaria was least in the neighbourhood of sullage farms. Everything depended on the extent to which the sub-soil water was polluted. There was evidence to show that it never extended below 100 or 150 feet, but he was not certain.

Sullage treatment at Lucknow.

Mr. Standley next introduced his paper (Volume II) on "Sullage treatment at Lucknow." The following is a brief summary :—

The paper deals with an experimental treatment of sullage at Lucknow, in which there was no fæcal matter. The situation was too central, but it had to be chosen, because the outfall of the system was near, and it gave the necessary head to work the filters by gravitation. There were three sets of contact filters, and two continuous filters, the dimensions of which are given. The analyses gave bad results in nearly all cases; only two good results were obtained, and those were from the contact beds. But on the whole all the filters seemed to have acted as mechanical strainers. Proposals were made to build more sedimentation tanks and reintroduce the septic tank which had been abandoned some time before on account of the smell; but as it was afterwards found possible to intercept the sullage in an intercepting sewer and put it on land, the experiment was eventually abandoned. The experiment shows the great difficulty experienced in getting rid of the sediments, mostly mineral solids that come with the effluent, and suggests that unless conditions are impossible the best treatment for sullage is to put it straight on the land, and in India especially both the soil and climate are eminently suitable for this method of treatment.

Reclamation of lowlying lands with refuse.

Dr. Master then read his paper (Volume II) on "Is it right to reclaim lowlying lands and swamps with refuse in a crowded city." The following is a brief summary :—

It is pointed out that the chief object of sanitation is to keep the air, water and soil as pure as possible, and much money is spent to this end. It is

therefore bad policy to fill in lowlying ground with rubbish because it is a cheap method of disposal. The air, water and soil are all so polluted, and not only so, but a nuisance of flies is caused. Lowlying grounds and swamps should be reclaimed by fresh soil, and though this will probably cost a considerable amount of money, it will in many cases repay expenses and may even be a source of profit. At the worst it will give a return in improved health and absence of nuisance.

Major Williams called attention to the nuisance caused by attempting to fill up swamps with rubbish.

Dr. MacDonald said that the nuisance in Rangoon was distributed by spreading the rubbish over a wide area in a thin layer.

Mr. Madeley called attention to the use of incineration in stopping dumping.

Dr. Master explained that what he objected to were dumping grounds near human habitations. He thought building on such land should be discouraged.

Colombo refuse destructor.

A " Note on a Colombo refuse destructor " (Volume II) was then presented by Mr. Cox, of which the following is a brief summary:—

A brief description of the 6-cell refuse destructor recently erected for the disposal of a portion of the city's refuse is given. The plant has a capacity of 60 tons per day and special appliances are provided to assist the incineration of wet refuse.

FIFTH DAY, NOVEMBER 15.

VISIT TO CONJEEVERAM.

Conjeeveram water-works.

The President and twenty-five delegates of the Conference left Madras by special train from Egmore at 7-26 A.M. to go to Conjeeveram to inspect the infiltration gallery and pumping station of the water-works.

Mr. Hutton, Sanitary Engineer, furnished the following particulars about the Conjeeveram water-works:—

Conjeeveram.—The town of Conjeeveram is situated 45 miles south-west of Madras, in the valley of the river Vegavati. At the site of the town this river is 1,000 feet wide, although its source is only distant some nine miles and it possesses a deep sandy-bed. Flood water is rarely seen in the river and the quantity is small. The river water has the reputation of flowing underground through the sandy-bed and thousands of acres of paddy are cultivated by spring or surface channels excavated in the sandy river-bed.

Population.—The population of the town has risen from 37,327 in 1871 to 53,864 in 1911. In addition to this population a considerable number of pilgrims visit the town especially in certain months attracted by its holy character and the sanctity of its two famous temples. The larger temple is dedicated to Siva and the smaller to Kamatchemma. There is a big temple dedicated to Varadarajaswami in Little Conjeeveram. In order to protect the town from cholera, etc., water-works were constructed in 1897, the designs of the same having been drawn up by Mr. H. Nowroji, Assistant Sanitary Engineer. The water-works were designed for a future population of 56,000 and the rate of supply was fixed at 15 gallons per head.

General description of water-works.—These works consisted of a gallery in the river-bed and a pumping station containing two sets of Worthington pumping engines which were used to pump water into the town through cast-iron distribution pipes provided with the usual public fountains. The scheme as constructed was a direct pumping one, but in order to minimise the disadvantages of this system a small service reservoir was constructed from savings effected on the sanctioned estimate.

Gallery.—The gallery as executed was 550 feet long and consisted of four rows of open-jointed 9-inch stoneware pipes surrounded by broken stone filling of a total depth of 7 feet, of which 6 inches is below the barrel of the pipes. The bottom of the gallery was fixed at a depth of 20 feet below the river-bed at the left bank of pumping station site. The broken stone filling is believed to have been put in of 1½-inch size. The four rows of stoneware pipes terminate in a connecting well on the river bank. From this well the water is conducted through a cast-iron pipe to the suction well, the end of the pipe being provided with a reservoir sluice, so that ingress of water into the suction well can be cut off when this well requires to be examined. The suction well is 10 feet in diameter with 18 inches steining and was sunk to the required depth by divers. It is protected by a roof of Mangalore tiles and is also ventilated. The suction well contains the suction pipes of the pumping engines and it is considered that the location of the well outside the engine-house building site is satisfactory, preventing any trouble from settlement due to drawing in of sand which occurs into pump wells located in engine-house sites and in sandy soil.

Pumping plants.—The pumping plant consisted originally of two sets of horizontal Worthington pumping engines and locomotive type boilers. After the water-works had been opened for some twelve years it was found necessary to instal Mr. Hutton's supplementary plant, as the two existing pumping engines had to be kept almost constantly at work in order to supply the increased demand of the town. Mr. Hutton recommended that the space left vacant in the engine house for a third set of Worthington pumping engines should be utilised for their installation, but it was subsequently decided by Government to instal

instead a suction gas engine working on Welsh anthracite. The installation of this gas engine necessitated the extension of the original engine house and this extension was made large enough to contain a fourth set of pumping engines of a type to be determined after experience had been gained of the working of the suction gas plant. Each steam pumping set is capable of pumping 583 gallons per minute against a total head of 56 feet. The suction gas plant is capable of pumping 584 gallons per minute against a total head of 69 feet.

Mains.—The water was distributed in the original scheme direct from the pumping station, the water main being 16 inches at the pumping station and decreasing in the town to 3 inches at the furthest point supplied. The distribution was therefore by direct pumping without the intervention of a service reservoir. Savings on the original scheme permitted the construction of a small masonry service reservoir in the town but at such a level that the higher parts were not benefited. This reservoir is used by manipulating the sluice valves daily and the attendant disadvantages of the arrangement have been obvious for some years. The variation of pressure against the pumps does not permit of a constant length of stroke and consequently the cost of working is higher than it would otherwise be.

Wastage of water.—The town is principally occupied by Brahmans and early after the opening of the works these householders obtained house connections without meters. The wastage of water at these house connections seriously affected the supply at public fountains and the higher parts of the town. Under the new Municipal Amendment Act, power has been obtained to fix meters on house connections and to charge for excess water. As a rule chairmen are averse to the actual fixing of the necessary meters, on account of its unpopularity but these meters will require to be fixed if the wastage is to be controlled.

Filter trenches and wells.—The spill-water at public fountains was usually run into roadside ditches where it stagnated causing a nuisance and encouraging the breeding of large numbers of mosquitoes. To remedy this state of affairs in the absence of a general drainage scheme, Mr. Hutton proposed the construction of filter trenches and wells. These were described as follows:—In towns which possess piped water supplies and no proper drainage it has been found that the spill-water from fountains forms either objectionable pools or stagnates in the roadside earthen ditches. In those pools and ditches mosquitoes breed in large numbers and complaints have been made on this account alone. The spill-water does not soak into the sub-soil at a sufficiently fast rate and it is necessary to devise means whereby the spill-water will be immediately conveyed under the surface of the ground so as to prevent stagnation in pools and the breeding of mosquitoes. Two type-designs have therefore been drawn up. The first one shows a filter well and the second a filter trench.

Filter well.—It is proposed that a well should be constructed, close to a public fountain, into which the spill-water would pass direct through a syphon trap. The well is shown as 4 feet in diameter and 8 feet deep. The bottom portion of the steining 4 feet in height will be of well brick in mud and the upper of the same brick in chunam mortar. The spill water will collect in this well and soak into the sub-soil. Any excess water received in the well during the day will soak away at night. The well top will be covered with stone slabs and a syphon disconnecting trap will be provided as shown to prevent any objectionable smell reaching the fountain platform. The well will be located on a favourable site in porous soil, the sub-soil water level being usually below the level of bottom of well. In such places where the well cannot be constructed close to a fountain, it will be costructed on adjoining land as near to the fountain as circumstances permit, a necessary connection being made by a pipe.

Filter trench.—The Sanitary Engineer has noticed at Conjeeveram that the spill-water of certain fountains is led to a ditch passing the roots of cocoanut trees. Unfortunately the soakage of the water in these circumstances is not sufficient to prevent a nasty pool forming by the roadside. To avoid this, a type-design of a filter trench has been drawn up. In this type-design it is proposed to lead the spill-water from a fountain suitably located into an open jointed sub-soil pipe surrounded by broken stone, through which the soakage of the spill-water into

the sub-soil will be rapid. A small cistern at the beginning of the sub-soil pipe is intended for pipe cleaning purposes. As in the case of the filter well where suitable soil does not exist near fountain, the spill-water should be led away by a stoneware or iron pipe to the nearest suitable location for the filter trench. The cost of the "filter well" at Madras rates will be about Rs. 50 and of the "filter trench" Rs. 20. The municipal authorities believe that these filter trenches have improved matters.

Cost of works.—The cost of the works originally proposed was Rs. 2,69,231 for a population of 56,000. This gives the low average cost of Rs. 4-8-0 per head of population. The low cost of the works is, in the Sanitary Engineer's opinion, principally due to the excellence of the site of the headworks close to the town and on a river which is not subject to high floods nor to scouring action.

Cost of working.—The average annual cost of working during the last three years was Rs. 16,363. The quantity of water pumped during the year was 234 million gallons, the average total height the water was lifted by the pumps being 34·14 feet. The cost of coal which was the fuel used for the steam plant was Rs. 18-12-0 per ton. The cost of Welsh anthracite suitable for the gas engine and delivered at Conjeeveram pumping station was Rs. 55 per ton.

Improvements proposed.—Owing to the small capacity of the low-level service reservoir and the fact that the distribution mains had been originally laid down for direct pumping, it has been found that it is impossible with present arrangements to supply all parts of the town with water at the requisite pressure. Proposals have therefore been drawn up for constructing an elevated service reservoir of 8 hours' capacity to be located at the pumping station site. It is also proposed to divide the town into three sections for supply and to lay new cast-iron mains and carry out alterations in the existing ones When this reservoir is completed, it will be possible to have pumping during the night so as to store water in the reservoir. The quantity of water to be supplied to the town will then be considerably more than the present supply. The quantity aimed at is 1,000,000 gallons daily. These proposals have not yet received sanction of Government.

Mr. Nowroji's paper (Volume IV) entitled "The water-supply of Conjeeveram" was taken as read.

SIXTH DAY, NOVEMBER 16.

FORENOON'S PROCEEDINGS.

The Conference met at 10-30 A.M.

PROBLEMS CONNECTED WITH THE MILK SUPPLY.

The utilisation of a continuous temperature of 50°C. for the preservation of the potability of milk.

The following is a summary of the paper (Volume II) on "The utilisation of a continuous temperature of 50° C. for the preservation of the potability of milk" by Military Assistant Surgeon Mackey :—

When milk freshly drawn is subjected to varying temperatures for varying times, it is found that little or no increase of bacterial content seems to take place for some eight hours at cold storage and room temperatures. At temperatures of 30° C. and 40°C. commonly regarded as incubation temperatures, an increase in the number of bacteria is perceptible at between the second and fourth hours of exposure. At 50° C. we observe only a steady decrease in the bacterial content. As this general bacterial content may itself be taken as the gauge of the potability of a milk, apart from the demonstration of the presence of pathogenic organisms, we may conclude that a temperature of 50° C. continuously applied will result in sterilisation of milk. It certainly will prevent multiplication of organisms. Now this temperature 50° C. is an easy one to maintain, is convenient in so far as milk so kept only requires slight cooling to render it usable by infants and can be employed for the preservation of milk in place of ice. These are advantages which may well recommend the procedure for stationary households during the hot weather. Absolute sterilisation of milk requires the application of high temperatures for considerable periods of time, and the qualities of milk are certainly changed in the process.

Major Harvey introducing the above paper said : "If you will look to page 2 of the paper you will see there a table which gives the facts upon which this paper is based. This table shows that a certain temperature, that of 50° C., is on the border line between an incubating temperature and a sterilising temperature. Organisms do not multiply at this temperature and in course of time are actually killed. The idea suggested by this result is that a very simple and easy method might be adopted in any stationary household for the preservation of the daily milk supply, so important for the preservation of the life of infants. The method suggested is only one of many but commends itself on account of its simplicity. It is easy to keep milk freshly taken, by means of a small kerosine oil lamp, continuously at this temperature of 50° C. and such a method would be much simpler than the use of ice. Definite sterilisation could be continued with this method of preservation. It is something of an advantage to a mother who has to prepare milk during the night for an infant, to have that milk already at a temperature which obviates the necessity for the milk to be raised to body temperature before administration."

Milk supply of Calcutta.

Rai Bahadur Kailas Chandra Bose then introduced his paper (Volume II) on the "Milk supply of Calcutta," of which the following is a summary :—

The paper points out the vital importance of an adequate supply of pure milk to a city where nearly one third of the inhabitants are vegetarians, and Indian mothers have largely to resort to artificial feeding. It points out that Calcutta is mainly dependent on supplies from outside, over which there is no control. The limited number of food inspectors cannot examine every sample brought in ; the health officer has no power to inspect precincts outside the Corporation limits, and the city is at the mercy of the unscrupulous class of milk dealers. Even the inconsiderable quantity obtained from Calcutta dairies is adulterated wholesale, and in spite of the Health Department *gwalas* keep their sheds and cattle in a filthy condition. The insanitary conditions prevailing are described in detail, and the sources of contamination in transit are pointed out. The remedies suggested are the amendment of the present defective Food Act, grant

of powers to the municipal bodies of the suburbs to license cattle sheds and restrict overcrowding, appointment of veterinary assistants to isolate sick cows, and no milk to be exported without his sanction, and the appointment of a commission to examine the question and devise remedies. Various regulations for cattle sheds, preventing overcrowding and protecting milk in transit are suggested.

In introducing his paper the Rai Bahadur said:—" In courting discussion on the question of the milk supply of Calcutta, I would only point out that milk, which is essentially necessary for the well-being of all sections of its citizens, has for more reasons than one been considered as a costly luxury inaccessible to the means of the poorer classes of people. The out-turn of the local dairies falls considerably short of the actual demand and the city has been compelled to depend greatly upon its neighbouring villages for its milk supply. When the sources of supply are indefinite, it becomes an arduous task to prevent its adulteration and unless we can do it effectively, we must always be prepared to meet with diseases of diverse kinds. I have on more than one occasion successfully traced the outbreak of cholera to this source. Professor Simpson, than whom no better sanitarian has ever come to Calcutta, mentioned an instance in which 20 sailors belonging to the vessel " Ardenelutha " were seized with cholera, of whom 4 died, and the cause was successfully traced to milk supplied to the ship by a local vendor. The present Food Act is defective and requires to be altered. In the last paragraph of my notes I have made a suggestion which, if adopted, might improve the conditions to a material extent."

Milk supply of towns.

Major Harriss in introducing his " Note on the milk supply of towns" (Volume II) summarised his proposals as follows :—

The paper is written with a view to suggesting a feasible plan of supplying good milk to the large towns. The micro-organisms in milk increase so rapidly that in 5 hours it may contain from 41,000 to 3,50,000 or even to 4,000,000 organisms per c.c.

The Germans found that the standard they proposed of 50,000 organisms per c.c. for good milk was an impossibility. It is most important therefore that milk should be protected from pathogenic organisms.

The chief diseases which may be spread through milk are—

I. Tubercle from the udder and dung of the cow and the sputum of the milk man.

II. Typhoid and cholera. Through the milk man as a carrier or in transit to the consumer by adulteration with infected water.

III. Epidemic diarrhœa, cholera, dysentery, etc., through flies in the house of the consumer or in the milk shops.

We have therefore to protect milk, at its source, in transit to the consumer or milk shop and in the milk shops.

Those who have visited the roads and lanes of large towns such as Cawnpore will have been struck by the large number of milk cattle stalled by the road side. A description of the disgusting condition of cows fed and milked by lepers as discovered in one place in Lucknow will show how urgent is the need for model licensed byres.

The measures taken for this purpose may be either repressive or constructive.

Repressive measures would consist in eliminating the smaller *gwalla* by stringently enforcing bye-laws for construction and encouraging the rich owner to build large dairies ; and constructive measures would be by the retention of the smaller *gwalla*, but compelling him to stall and keep his cows in sanitary model byres. Dairies and model byres may be situated in three positions—

(1) in a quarter of the town embracing several contiguous *mohallas* ;

(2) on the outskirts of the town ; and

(3) along the railway lines within a reasonable distance of the town.

The advantages claimed by the dairy inside the town are—

(1) that they would be easily supervised ;

(2) that milk would not have to travel far to the customer ;

(3) that if adulterated with water, tap water would be in most instances used and the possibility of the spread of cholera and enteric in this way avoided ; and

(4) that the milkman, if tuberculous or an enteric or cholera carrier would be more easily dealt with. Most of the cattle in large towns are already stall fed.

The model dairy and byre system would be adopted gradually. As the byres were erected, the bye-laws enforcing their occupancy by the prohibition of cow keeping in private compounds within that quarter of the town would be gradually enforced. *Gwalas* occupying model byres would have the right to purchase fodder grass from the sullage farm at preferential rates.

The introduction of milk from dairies situated in a ring round the city or up to a distance of 2 or 3 miles from it is open to the following objections :—

(1) difficulty of supervision ;

(2) liability to infection by cholera and enteric, etc., from adulteration by infected water ;

(3) difficulties of provision of pure water supply for butter making ; and

(4) dairies along the railway line if properly managed should prove excellent. The objection to this position is the temperature to which milk is exposed in transit. Time and temperature are two most important factors in the increase of micro-organisms in milk.

If the milk supply comes from positions along the railway line the following system might with advantage be adopted :—

(1) model receiving depôts at the stations of despatch ;

(2) supervision of cows and byres from which milk is received at this depôt ;

(3) the water-supply must be above suspicion ;

(4) at the depôt there should be sterilizing and refrigerating plant ;

(5) the milk should be sent by rail in refrigerating cars ; or

(6) the milk should be pasturized.

The receiving depôt would distribute it to hawkers and milkshops. All hawkers and milkshops must be licensed and hawkers and milkshop attendants must wear distinctive badges and numbers. For the testing of milk the Health Officer would be responsible. To refuse or evade giving a sample to the inspector appointed for the purpose should be an offence under the Food and Drugs Act, when a milk standard for India has been decided on. Appeals from the Health Officer's decision might be to the public analyst.

Some practical points in the Indian milk problem.

Dr. Newell next presented his paper (Volume II) on "Some practical points in the Indian milk problems and how they may be tackled" of which the following is a summary :—

In this paper some practical points in the physiology and bacteriology of milk are dealt with, and the best method of obtaining aseptic milk production in Indian conditions is discussed. The chief requisite is to obtain a class of dairy men trained in the production of clean milk. The various diseases that can be transmitted by milk are enumerated, and it is pointed out that the experience of the writer shows that tuberculosis in cattle is uncommon in India. Municipal control, inspection and education of the public are dealt with and the following recommendations are made.

1. Local Governments should train men for dairy work who would be certificated.

2. Veterinary students should be trained in the sanitary conditions necessary for the production of clean milk.

3. Certificated dairy men should be engaged by municipalities and given free to all dairies, and a trained Veterinary Inspector engaged for inspection work.

4. Municipalities should encourage the outside production of clean milk by reducing octroi charges and giving prizes.

5. Sanitary conditions inside municipal limits should be encouraged by a system of 1st class licences with prizes.

6. All first class municipalities should provide a laboratory for milk analysis.

7. For all other municipalities, a provincial laboratory, to which samples could be sent for tests, should be provided.

8. A milk commission should be appointed to decide on minimum sanitary requirements for shops and dairies ; the question of grazing and fodder for cattle and the best means of improving stock ; a uniform standard of tests; to fix the chemical and bacteriological standard required for milk, and to define adulteration and generally to make proposals for improving the milk supply.

In reply to the questions of certain members Dr. Newell said the training of *gwalas* could be undertaken in connection with veterinary colleges. A month's training should be sufficient and municipalities also might have a model dairy. He admitted that these were suggestions only and that they had not yet been carried into practice.

In answer to Dr. Rutherford he said that most municipalities had at present no control even within municipal areas.

Dr. Rutherford stated that in Colombo the milk sellers were controlled by licences. This had resulted in a considerable reduction of adulteration. He admitted however that the price of milk had gone up somewhat.

Captain Dunn thought that the enhancement of prices as a result of control greatly increased the difficulties connected with the problem.

Dr. Newell said that of course one of the results of the scheme would be that price of milk would be increased. On the other hand municipalities would derive a considerable advantage in having trained *gwalas* instead of the present illiterate and irresponsible class of milkman.

Rai Bahadur Ganga Prasad Varma thought that control would be impossible without separate sheds and a separate inspecting staff. Municipalities, however, might be encouraged to have their own dairies which would sell milk at reasonable rates. He thought that such dairies could be worked at a fair profit. The price of milk had gone up by 100 per cent. during the past four years.

Dr. Newell disagreed with Rai Bahadur Ganga Prasad Varma about the impossibility of proper inspection. In his opinion it was the duty of every large municipality to provide an adequate sanitary staff for the purpose of inspection. With regard to the increase in the price of milk he thought this was due to many causes, for example, the growth of population and the larger demand for milk.

Dr. Macdonald said that the difficulty in Madras was mostly confined to George Town and Vepery. He thought that it did not matter how carefully cattle sheds were built if the neighbourhood was congested and unhealthy. The Corporation were willing to undertake the building for cows, and this will be the first step towards the supervision of the milk supply by the Health Department. He did not think there would be any difficulty in carrying out the supervision, as they already had sanitary officers doing similar work. They were going to start by building one shed, but more will probably follow if this is successful.

Dr. Rutherford said that one result of controlling the dairies in Colombo had been that it was driving the milk supply out of the hands of ignorant *gwalas*, into

those of a better class of people. It was quite usual to have a service of quite good and responsible people, so that the first effect was to change the personnel of the dairies.

VITAL STATISTICS.

Mortality in the Cossipore-Chitpore municipality.

Mr. Bipin Bihari Brahmachari introduced his paper (Volume II) on "Mortality in Cossipore-Chitpore municipality" of which the following is a summary :—

"It is explained that the object of the paper is to show how an inaccurate register of vital events will keep us in the dark as to the influence of defective sanitation on public health. It is claimed that in this town it has been brought to a fair state of accuracy, and that this can be done elsewhere. Details are given of the measures that have been taken to improve registration in the town. It is shown that with the existing returns and headings in the register, no correct statistics are given of the extent of various preventible diseases. It is suggested that the register of the towns may be transferred by degrees from the police to municipal commissioner. Cremation and interment may be restricted under heavy penalties to the places registered under section 254 of the Bengal Municipal Act, or, in cases of villages sanctioned for the purpose, and in order to have a correct record of the cases, the entries may be checked by a medical man, and the headings may be more definite and a separate column should be allotted to tuberculosis."

Mr. Bipin Bihari Brahmachari in introducing the paper said that registration of deaths is extremely defective both in quantity and in quality on account of the system which obtains at present, *viz.*, registration at thanas instead of at the places of disposal and by men having no medical knowledge. Registration may be improved if measures like those which he had suggested on the last page of his paper could be carried out.

Vital statistics, Bengal.

Dr. Bentley then presented his paper (Volume II) on "Vital Statistics, Bengal" of which the following is a summary :—

In this paper a description is given of test enquiries made in a type area in the district of Dacca in 1911-1912, in order to provide data regarding the actual causes of death in the light of which it would be possible to assign a truer value to the present mortality returns. The method of enquiry is described. The cause of death was verified in 8,000 cases, 10,000 births were verified and 61,000 cases of sickness seen (and largely treated).

The following points of general importance were noted :—

1. Omissions on the part of *chowkidars* to record births numbered 6 per cent. of the whole and of deaths 4 per cent. These figures give a false impression, as great improvement in accuracy of reporting was caused by the enquiry itself.
2. The only returns of any value as to cause of death, are those relating to cholera and small-pox. Fever is absolutely misleading. This is largely due to the routine method of reporting insisted upon. Local terms are used describing various forms of disease and these the village watchmen employ, but as they are not recognised in the schedule they go down as "fever" or "other causes."

It is suggested that a check might be exercised by utilising the services of *patwaris* and schoolmasters to keep special registers. By this means the latter class might be interested in matters of hygiene. It is also urged that the improvement of registration is the most pressing of all sanitary reforms.

Dr. Chandra Sekhar said that they all recognised the necessity for improved village sanitation and accurate vital statistics. Under present circumstances it

was impossible to do anything as regards village sanitation because they lacked accurate knowledge of the presence of infectious and epidemic diseases in different parts of the country. He would suggest a system of grouping villages within a radius of, say, 5 or 10 miles under a village union and making the same regulations for the villages that exist in the various town municipalities. If this were done the village union would take pride in the administration of its affairs, and in their desire to emulate the good examples of neighbouring villages, would do their best to improve the condition of their own village union. His suggestion amounted to the extension of the local self-government principle to villages. He thought it would be well to give this a trial in some selected districts where infectious or endemic diseases might be prevailing more than in neighbouring districts, and the experience thus gathered would be very useful.

Major Clemesha said that as regards vital statistics, most of the suggestions made by Dr. Chandra Sekhar were actually in vogue in Bengal. It was true there were not committees in every union, but the mechanism proposed by Dr. Sekhar was at work.

Colonel Wilkinson said that in the Punjab at present the agency for the collection of vital statistics was the police, but he thought that if the revenue agency was employed for this work they would be able to do it much more thoroughly, as revenue officers were to be found in every village whereas *chowkidars* had to go long distances to thanas, in order to make their reports.

The President said that this was a matter which local Sanitary Commissioners could bring if necessary to the notice of their respective Governments.

Dr. Nair said that in recommending changes, principles should be kept in view rather than details. The principle he would recommend local Governments to keep in view was that where qualified medical men could not be got to certify the cause of death, there ought at least to be medical men as registrars of deaths who could, to a certain extent, verify the cause of death. Unless this were done, no matter what agency was employed for collecting vital statistics, the statistics would be absolutely useless, as those who collected them would for instance put down all conceivable diseases under the heading of fever. In Madras city they had found such statistics quite unreliable and had replaced the death registrars by medical men. He thought it a practical suggestion that registrars of death should be medical men. He also considered Dr. Sekhar's suggestion regarding the grouping of villages a good one. A sub-assistant surgeon could do the work very well in a group of villages.

Dr. Rutherford said that in Ceylon the assistant registrars were all Government Apothecaries and the registrars were native medical men.

Major Liston said he had made a calculation of the cost of a somewhat similar scheme for Bombay presidency, which showed that an annually recurring expenditure of something like 10 lakhs would be necessary. The question of such a large expenditure was a serious one.

Mr. Moti Lal Ghose thought the main objection to Dr. Nair's proposal was the expense involved.

In reply to a question from Major Lalor whether the introduction of professional agency for vital statistics was the result of a process of slow evolution or a sudden and abrupt change, Dr. Nair said that in Madras city the change had been sudden.

Major Williams said that there were no medically qualified men in rural areas in Burma. If a resolution was passed on the subject, he thought it should be limited to laying down that a medical agency for the collection of vital statistics should be employed in towns and that no one with lower qualification than that of a sub-assistant surgeon should be employed there.

EDUCATION AND HYGIENE.

Education in public health.

Major Stokes next presented his paper (Volume II) on "Education in Public Health" of which the following is a summary:—

In this paper the necessity of approaching the problem of ignorance and apathy more directly than by waiting for the general education of the people is dealt with. It is suggested that a tabular statement of the requirements of each *mohulla* and of the points requiring his supervision should in towns be permitted to each municipal member, and that it should be made a *sine qua non* that all schoolmasters should possess a knowledge of the rudiments of hygiene. The book teaching hygiene to boys does not afford much hope ; to utilise the assistance of the schoolmaster (in conjunction with medical inspection of schools) appears the better course. The two classes in rural areas who have most opportunities in this direction are policemen and vaccinators. A simple primer of sanitation is under preparation in the Central Provinces for the latter, and a table of diseases in groups for the use of the former in reporting.

Major Stokes said :—" The point I wish to bring forward in my note is that sustained measures for the dissemination of knowledge form the most urgent necessity of preventive medicine in India today. The great mortality amongst the people arising from sheer ignorance must be vastly greater than the total lives saved by all the specific remedies known. What is required, it seems to me, is a definite practical policy, however slender, directed to the popularisation of simple knowledge and numerous ways and means have been suggested in the various papers we have recently heard. We have been told in the presidential address that sanitation and education in India have been linked together by no idle chance but we shall have to wait a long time before general education or the spasmodic efforts made in epidemic emergencies can bring about the desired result. At present the educated are often the most difficult to deal with. We require to devise a short cut by which direct co-operation between the two departments may be effected and the most practical way of obtaining this appears to me to be by recommending that all schoolmasters be educated in hygiene. The influence of these men is wide spread and in a quiet, practical way much could be done by them to create public opinion and subdue prejudice. There are many here who have more experience in this subject than I have and it would be interesting to hear their experience and proposals."

Mr. Moti Lal Ghose said that he thought the people who lived in the villages knew as much of the value of ordinary hygienic rules as anyone present at the Conference, and he would only recommend the education of the masses in these principles, if education could supply them with good drinking water, if it could provide them with better drainage and if it could secure for them better conservancy, or enable them to cut the jungle with which their villages are covered. From mere education however he thought very little results could be obtained. What was needed was to provide the people with funds so that they could manage to have better drainage and a purer water-supply.

Major Liston said :—" In attempting to formulate any scheme for popularising knowledge of the cause and prevention of disease it is necessary to know something of the magnitude and importance of the task.

The population of the Bombay presidency exclusive of Native States is—

19 millions of whom 2 millions are literate, 4 millions live in 200 towns, and 15 millions live in 26,000 villages over an area of 123,000 square miles.

When to the immensity of this scattered village population there is added illiteracy, poverty and indifference the task of teaching the people something about how they may maintain themselves in health and strength seems almost superhuman. Yet it must be remembered that on the imparting and assimilation of this knowledge depends the demand of the people for sanitary reform. Progress in sanitation in India cannot get on without a call for reform on the part of the people themselves. When I come to study what is being done in this direction in this country I find in the first place that no particular department is responsible for educating the people in a knowledge of hygiene. Pamphlets and hand bills are prepared at one time by the Sanitary, at another by Medical, Revenue or other authority or it may be by one of the research laboratories. The methods adopted for conveying information on hygiene to the people seem to me to be haphazard and spasmodic and our efforts are not sustained.

The knowledge is imparted by an untrained agency at an inopportune moment. In my paper on "Plague preventive measures" I have stated that the ideal remedy for these defects lies in the creation of a large sanitary organisation which would have ramifications in every village but such a scheme in the present condition of the country would be financially inpracticable, but I think much could be done now at a fraction of the cost were our methods better organised.

In the first place, some department should be held responsible for the diffusion of knowledge regarding the spread and prevention of disease. It seems reasonable that a department actively engaged in research of this nature should be the department selected for the purpose. In other words, a bureau for the collection and diffusion of knowledge in regard to preventive medicine should be associated with each research laboratory.

In the second place a suitable staff should be provided for the purposes of the bureau. Persons engaged in research are not always the most fitted to communicate their findings to the public. Success in imparting information depends largely on the manner of its presentation. Persons should be selected for this purpose who have a facile pen and a gift of making the subject on which they write simple and interesting. If possible these accomplishments should be associated with the power to organise.

In the third place the department responsible should be furnished with funds for the purpose of popularising a knowledge of hygiene. The preparation of books and pamphlets well illustrated would constitute a part of the duties of the bureau.

In the fourth place an attempt should be made to utilise each and all the following existing organisations for the diffusion of knowledge so that those who can read may communicate the information to the illiterate :—

(1) The Revenue Department.

(2) The Medical and Sanitary Departments.

(3) The Police Department.

(4) The Educational Department.

(5) The Postal Department.

(6) The District and Taluq Boards.

(7) Village Sanitation Committees (Bombay Act of 1889).

(8) Railways.

(9) Agricultural, Co-operative and other Societies.

(10) The Press.

(11) Private Medical Practitioners, *Hakims* and *Vaids*.

(12) Priests, *Mullahs* and Missionaries.

(13) Markets and Fairs.

In the fifth place centres for teaching by demonstrations and lectures should be established. We have arranged such demonstrations at the Parel Laboratory and it may interest the members of this Conference to learn something of the nature and success of these demonstrations.

With the assistance and co-operation of Mr. Fraser who is in charge of the High School Teachers Training College in Bombay I gave a course of eight popular lectures on Saturdays to his students. Some thirty teachers attended the class. I understand that the teachers enjoyed their visits to the laboratory and as Mr. Fraser has expressed it in a letter to me "they found the new world of your laboratory very interesting. I believe they look on the course as a privilege." The plan of the lectures was as follows :—The first lecture dealt with parasites in general illustrated by the common ecto and endo-parasites of man. Living specimens of bugs, ticks, lice and fleas in various stages of development from egg to imago were demonstrated. Their habits were discussed, the pathological conditions they produce were illustrated in patients or by wax models.

The means by which these parasites can be destroyed and how they can be avoided were detailed. All the common endo-parasites were illustrated by exhibiting preserved specimens; how they gain an entrance to the body and how they produce disease was described. In the second lecture I passed from the larger parasites which were easily visible to the naked eye to the more minute parasites which inhabit the tissues and blood of man such as for example the guinea worm and the blood worm filaria nocturna. A description of these parasites enabled me to say something about the phenomena of alternation of generations, the specificity of hosts and hyperparasitism. I then in the next lecture passed on to the still more minute malaria parasites which inhabit the blood and which are transmitted by mosquitoes. From this in the next lecture I led them to consider plague and the minute organism which produces this disease. Vivid impressions were made upon the minds of the students by exhibiting numerous illustrations of the subject discussed. Photographs, living and prepared specimens, both macroscopic and microscopic and when possible persons suffering from the diseases were shown to the students. By these means and especially by leading the students from the larger parasites to gradually smaller and even microscopic parasites they came, I think, to realise the true nature of parasites, they became familiar with and understood what microbes really are and how they produce disease. The lecture was further impressed on their memory by writing out on a black board an outline of the lecture which the students had to copy into their note-books before the lecture. By this means they were not distracted in their endeavour to take notes and could therefore follow more easily the text of the lecture. Mr. Fraser a few days later questioned them on the lecture, corrected wrong impressions and asked them to prepare an essay on what they saw and heard. A few selected essays, each prepared by a different student indicate, I think, that the lectures have not been given in vain and Mr. Fraser proposes to publish them.

The experience I have gained leads me to suggest the institution of, say six lectures and demonstrations on the following plan.

Lecture 1.—Parasites in general, especially the larger parasites of man, the morbid conditions which they produce.

Lecture 2.—The more minute parasites, especially those illustrating the phenomenon of alternation of generations as for example the guinea worm, filaria nocturna and malaria.

Lecture 3.—A lecture on plague which will afford an opportunity to say something about the structure of houses, the effect of light and ventilation, the proper disposal of rubbish, etc., in preventing the spread of this and other diseases.

Lecture 4.—A lecture on tubercle which will form a text for some remarks on the advantages of a clean and healthy milk supply. It will also afford an opportunity to say something of the dangers of promiscuous spitting, coughing and like habits which especially favour the spread of this and certain other diseases.

Lecture 5.—A lecture on intestinal disorders like cholera, dysentery and typhoid fever which will allow a discussion on the proper disposal of excreta and garbage and enable one to say something of where flies breed and how they spread disease. The advantages of a pure water-supply will also be discussed.

Lecture 6.—A lecture on small-pox and vaccination, measles, whooping-cough and other specific infectious diseases will enable one to discuss infection and recovery from disease, and the general principles underlying vaccination and inoculation. The occasion will also be taken to say something about the treatment of disease in general.

The experience I have gained during the past year both in teaching and in talking to Indian gentlemen leads me to believe—

(1) that even educated Indians, graduates of our universities, have very little knowledge of how disease is spread and how it may be prevented. They look upon disease with superstition and dread, they cannot understand the reasons for the preventive measures often advocated and pushed by Government and therefore frequently resist and frustrate these measures although they may believe that sometimes the measures have been adopted with the best intentions;

(2) that in an institution such as the Parel Laboratory where we are in close touch with disease and can demonstrate the causes which produce particular diseases and can show how these causes can be removed or destroyed we have an opportunity for instructing intelligent persons in these matters. Experience shows that graduates at least are able to understand the causes which produce disease how these may be removed and health maintained. Simple facts bearing on the points at issue without reference to the why and the wherefore may be all very well for children and the illiterate but for intelligent persons and they after all are the people who guide and control the others it is necessary to know something of the underlying reasons. With these views before me I think the somewhat elaborate course of lectures I have outlined is necessary.

I have been in correspondence with all the Sanitary Commissioners throughout India; they have been kind enough to send me an account of what is and has been done to popularise a knowledge of the cause and prevention of disease in their several provinces. I feel sure you will not fail to agree with me that such efforts as have been made are poor indeed. As I have pointed out the efforts have been spasmodic and ill organised. I am also in communication with the various educational authorities in England, America, Germany and France but regret that up to the present I have only received a reply from the American Bureau of Education. In accordance with the suggestions made in that reply I have addressed the doctors in charge of the State Board of Health of each of the States mentioned in his letter."

Surgeon General Sir Pardey Lukis said: "With reference to the admirable remarks of Major Liston I should like to say that on the occasion of our last meeting in Bombay an educational sub-committee was formed under the orders of the Scientific Advisory Board of the Indian Research Fund. Major Liston is himself a member. Since then we have been collecting a large number of papers and I propose next week to have a meeting of the sub-committee when we hope to discuss the whole matter and to put up proposals on the subject. One other thing I should like to say is that though I entirely agree with Major Liston's remarks about the ignorance of educated Indians as regards sanitary measures yet they apply equally well to a large number of educated Europeans."

Dr. Master thought that they were more concerned with the rural masses for whom elementary lessons in preventive medicine in villages were necessary, than in holding classes for educated people. They had tried holding such classes for the Parsees and although that community was unusually advanced they found it very difficult to get people to attend them. Sanitary primers existed but were not regularly taught in village schools.

Mr. Moti Lal Ghose was of opinion that the village people did not need to be enlightened on sanitary points. They had sufficient knowledge of what was good and what was bad from a sanitary point of view. If their habits were insanitary it was because they had no facilities for cleanliness and health. Improvement in the sanitary conditions under which they live was required rather than instruction in the principles of sanitation of which they were well aware. What they needed were the necessaries of life and these could not be supplied by education alone.

Major Harriss said: "In the United Provinces lectures on malaria with lantern slide demonstrations are given in normal schools every second year. In alternate years we propose to give lectures on hygiene in normal schools probably through the agency of district sanitary officers. In schools children 12 to 14 years old are to be taken out for field demonstrations the course for which has to be accepted by the Director of Public Instruction. They will be shown where to find larvae, they will see them hatch, and will be taught to recognise the difference between the culex and anopheles, and will be instructed how to destroy larvae in their actual breeding places."

Dr. Rutherford stated that the teaching of school classes in hygiene in Ceylon had been going on for the last six years.

Dr. Bentley said: "There is great need for educating the literate as well as the illiterate in regard to sanitary matters. For instance in Bengal few of them really know what pure water is. Recently I had occasion to visit a middle English school in Bengal. I asked the headmaster if they taught any lessons in elementary hygiene there. In reply he showed me a reading book containing lessons on sanitation, including one upon pure water. I asked what water the school boys used and was told "water from a *khal* adjoining the school." The *khal* was within 10 yards of the school and as I had stepped ashore from my boat it was with the greatest difficulty that I could avoid the human excrement which lay thick about the water-edge. Another illustration of the ignorance of sanitary matters shown even by members of the middle classes was brought to my knowledge a short time ago. An educated man built a privy over a portion of a tank from which his family obtained their water, in order to afford evidence of part ownership of the tank. When it was pointed out to him that as a result he and his family were consuming their own excrement he excused it by saying "Oh, but it is only in very diluted quantities."

The President said: "I think I may say that a good many of the Education Departments in India are considering this question of instruction in sanitation and it has been up for some months before the Government of India. We have already heard from Major Harriss what they have done and are going to do in the United Provinces and other provinces are also realising the importance of this question. I think that in every country now the importance of this question is realised and it is not only in this country that the habits of the people are insanitary. I think we all appreciate the importance and I might also add the considerable difficulty of the subject. But to get hygienic principles instilled into the masses is of course a matter of very considerable time, organisation and labour. The lectures which Major Liston has given have no doubt been productive of the best results but we want to go further than that, to the training colleges and even to the normal schools in order to carry out any extensive system of hygienic instruction, and as has been indicated there is probably scope for the co-operation of several departments on this very important subject. The whole thing will require to be thought out very carefully. It is really one of the most important matters for discussion in this Conference."

Medical inspection of school children.

Dr. Amritaraj then introduced a paper (Volume II) on "The medical inspection of school children in India" in which he suggested that a system of inspection of schools similar to that adopted in England and other European countries should be started in India. To begin with it would probably be sufficient to start on a small scale with towns having health officers. There would probably be little opposition and the system might be combined with the education of the children in simple hygiene.

Major Stokes said that the system had been introduced in the municipal schools in the Central Provinces in the last year, but owing to the difficulty of obtaining medical men for district inspection, the scheme had been discarded as an impossible one.

Colonel Wilkinson said they had inspection of eyes in several towns in the Punjab. In most towns there were one or two sub-assistant surgeons and in the bigger towns assistant surgeons, and a possible beginning could be made.

Major Clemesha said that in Bengal they had no medical inspection at all. The only medical inspection that was carried out was done by the Education Departmeut.

Rai Bahadur Ganga Prasad Varma said that in the United Povinces there was no regular examination. He thought this desirable so long as there were lady doctors to examine the girls.

RURAL SANITATION.

Sanitation of villages and small towns.

Khan Bahadur Syed Mehdi Shah introduced his "Note on the sanitation of small towns and villages" (Volume II), of which the following is a summary :—

The various sanitary improvements which have been made in Gojra and Mehdiabad are detailed with some of the difficulties which have been encountered. The improvements include water-supply, roads, drainage, housing, tanks, surface cleanliness, etc., and it is stated that the results on the general health of both places have been excellent. Similar improvements are recommended to be carried out elsewhere.

Rural sanitation in Bengal.

Mr. Moti Lal Ghose then presented his paper (Volume II) on "Rural sanitation in Bengal", of which the following is a summary :—

Fifty years ago the population of Bengal was for the most part a rural one. The people were in good circumstances; fish and vegetables were to be had in abundance and prices were low. About that time epidemic of Burdwan fever broke out in the province, and spread throughout India: severe epidemics occurred in the Nadia and Jessore districts. The identity of this fever is not definite; at first its ravages are swift and deadly, but after a few years it approximates to the type of malaria, which though slower in its operation is no less deadly. Burdwan and Dwarbashini were involved in 1861, and shortly after other districts were affected. The Epidemic Fevers Commission was formed in 1864, which ascribed the sickness to miasm, polluted drinking-water, deficient ventilation, to the excessive use of farinaceous foods, and to a slight extent to contagion. The recommendations of the Commission were chiefly directed towards methods of reducing the miasm or malarious exhalation which arises principally from moisture in the soil during the drying process after the rainy season. Schemes of drainage and the prevention of the silting up of rivers were proposed, and attention was drawn to the increasing poverty of the people as one of the predisposing causes of the disease. Unfortunately none of the recommendations of the Commission was carried out. By this fever, then, Burdwan, which before the advent of the epidemic was one of the healthiest and most prosperous districts in Bengal, was laid low. Villages have disappeared and jungle has taken their place; the death-rate is abnormally high and frequently exceeds the birth-rate; the people are malaria stricken, and from the lack of energy thus engendered in them has followed the poverty and misery which now exists. Food is scarce, water-supplies are polluted, jungle and weeds have gained access into the villages, natural drainage has become obstructed.

The writer then refers to the influence of poverty in increasing the mortality from malaria. Embankments and borrow-pits in connection with railways and raised roads were sources of danger as they obstructed natural drainage. It is remarkable that in pre-malaria days there were no raised roads, but only village tracks. The problem was then one of village sanitation, and drainage and water-supply were the most important of the problems to be dealt with. As regards drainage, villages should be rendered as dry as possible by removing obstructions to the free egress of water, jungle must be cleared, useless tanks filled up, and the obstructive effect of such obstacles as raised embankments must be remedied

by increasing the number of culverts. Borrow-pits must not be dug in the proximity of villages and should not be made without due provision for their drainage.

Regarding water-supply, the writer draws attention to the degree of pollution which exists. He considered that each village should have at least three tanks—one for drinking, one for bathing, and one for jute steeping. The jute industry has materially added to the prosperity of the ryots, but it has exacted its price. The jute fields are breeding places for mosquitos, the stench which jute steeping produces is almost unbearable, and if the steeping is done in a tank the water becomes undrinkable, and the fish die. The writer suggests that if borrow-pits were connected up, they might be used for this purpose. The most important problem then in Bengal is that of rural sanitation, and to bring about an improvement attention must be devoted primarily to drainage, water-supply and jungle-cutting. Whilst a firm believer in the benefits of education he holds that sanitation should come first. Much money will be required, and he advocates the allocation of the road-cess fund for this purpose.

Mr. Ghose in introducing his paper said he ventured to think that more time should have been given at this Conference to the subject of rural sanitation, which was a comparatively important subject. The sanitary condition of Bengal villages had changed for the worse during the last 60 years. The Bengalis were a dying race. This was mostly due to malaria and partly to cholera. He said the Conference were well aware of the measures which should be undertaken. He drew attention to a drainage committee which had been convened in Bengal in 1906. He deplored the fact that owing to the death and decay of cattle, milk was rapidly disappearing from Bengal. As regards water-supply heart-rending scenes were witnessed in Bengal from April to June each year when people had to go for miles to fetch water or rather to be more accurate for diluted sewage. He drew attention to the close connection between poverty and malaria and quoted extracts from his paper to illustrate his point. The water-logged condition of villages was also a fruitful source of disease. In his opinion the best method of combating malaria was to give the people good drainage and pure water. He doubted the efficacy of mosquito brigades or the indiscriminate distribution of quinine. He appealed to the President and said that he pictured him as a man with two wives, these being education and sanitation. Though an ardent well-wisher of mass education he nevertheless lamented the fact that the President had treated education too much as his favourite wife and quoted figures of grants in recent years by the Government of India to illustrate his point. He concluded by referring to the practical interest taken by His Excellency the Governor of Bengal in the subject of rural sanitation and appealed to the Government of India to localise the public works cess entirely for the purpose of giving more financial assistance to rural sanitation. The total proceeds of the road cess also should be devoted to sanitation.

Rai Bahadur Kailas Chandra Bose expressed his agreement with Mr. Moti Lal Ghose as regards the building in former years of village houses on hygienic lines. He disagreed with him as regards the non-existence of malaria in Bengal 50 years ago. He thought with Mr. Moti Lal Ghose that borrow-pits and holes should be filled up so far as possible as these were a fruitful source of malaria but he hoped that Mr. Moti Lal Ghose would give them the assistance of his pen in advocating a wide distribution of quinine. In conclusion he quoted the Hindu scriptures as favouring the destruction of both mosquitoes and rats.

Village sanitation.

A paper (Volume II) on "Village sanitation" by Syed Zahir-ud-din was taken as read.

ADULTERATION OF FOOD AND DRUGS.

Inspection of food and drugs.

Dr. Nair then introduced his paper (Volume II) on the "Inspection of food and drugs in relation to Public Health", of which the following is a summary :—

The paper is based on conditions existing in Madras. It is pointed out that deaths from bowel complaints form a very appreciable proportion of deaths

from all causes in the city, and that a large proportion are directly traceable to impure food. The staples of food are enumerated, and the methods of adulteration described in each case.

Detailed suggestions are made for the amendment of the food and drug sections of the Madras Municipal Act and it is further suggested (*a*) with reference to the importation of impure food, that the public health authorities should be empowered to board steamers or vessels, to inspect and to prevent the landing of impure food, (*b*) with regard to *ghee* that a standard of purity should be fixed, and the adulteration of *ghee* made a criminal offence and (*c*) with regard to milk supplies, that standards of purity should be fixed both for cow's and buffalo's milk and enforced by the co-operation of the public analyst and the food inspector with the aid of the criminal courts ; that cattle yards should be improved and the theoretical standards existing should be translated into practical action.

In introducing his paper Dr. Nair referred to the recent letter of the Government of India asking for the opinion of local Governments on the subject of the adulteration of food and drugs. Speaking from a municipal point of view he thought that drugs and food should be separately dealt with. They had little or no experience of drugs and therefore any expenditure in connection with the inspection of drugs should, he thought, be incurred by Government and not by municipalities. He considered that the inspection of drugs should be embodied in a separate Pharmacy Act which should be common to the whole of India. Turning to the question of the adulteration of food he referred to the practical difficulties surrounding it on account of the insufficiency of control and the deficiencies in municipal Acts. In his opinion local amendments and local legislation were more suitable than a general Act for the whole country since it might be difficult for an all-India Act to embody in an adequate way all local requirements. He concluded by asserting that education by itself was not sufficient for preventing adulteration without the assistance of special legislation *ad hoc* and in this connection quoted the experience of England.

Mr. Moti Lal Ghose said that adulteration of *ghee* and milk was due to scarcity of milk and the remedy did not lie in any legislation, which would indeed enhance the evil by killing the small milk trade which still remained.

Dr. Rutherford said that a Bill on the subject of adulteration was now before the legislative council in Ceylon.

Dr. Newell thought a general Act would be preferable provided it gave adequate powers to local Governments to deal with local requirements. He thought a separate Act for drugs was necessary which should also be general and he advocated the prohibition of the importation of adulterated drugs.

Captain W. C. Ross was of opinion that the Act whether general or local should be capable of extension to extra municipal areas, where much of the mischief lay.

RURAL WATER-SUPPLIES.

The Government of India recently asked for information as to the arrangements in each province for the provision of protected wells in rural areas, and the following replies received from the Provincial Sanitary Commissioners were laid before the Conference.

Madras.

The chief sources of water-supply in rural areas are from rivers, tanks and wells. In the dry weather the people dig pot wells in the river bed. These pot wells are potent factors in the spread of cholera.

Tanks are reserved for drinking purposes and others set apart for bathing purposes by local bodies. They are guarded by watchmen but the latter are not reliable and a stranger to such a village water-supply can hardly be expected to discriminate between the drinking supply and the tank used for bathing purposes. Recently cholera in the villages of Bellary district was traced to a man bathing

his legs in the village step well to relieve the cramps which accompany the disease. Every effort is being made to conserve the village drinking water tanks by advising the adoption of our recent type design. I have consulted the Presidents of District Boards regarding the steps taken by Local Boards for providing drinking water by means of wells in rural areas during the last five years.

From the information received it appears that very much has not been done in the past in the way of providing protected wells.

The public wells in use in villages are as a rule draw wells with or without pulleys. They are of a primitive description, defective in design and construction which afford no protection against surface and subsoil contamination. Most wells have parapet walls, a few platforms and rarely are wells found with collecting and lead off drains so that the amount of stagnation and soakage is very great. The use of type design wells is now generally recognised and every effort is made by Local Boards to construct such wells as far as funds permit. In Administration and other reports and in forwarding proposals from Local Boards for the construction of wells, my office has always advised the putting down of protected wells according to type design and fitted with pump and cistern with taps. As far as possible step wells are being converted into draw-wells.

Bombay.

In the rural districts of the Deccan and Gujarat drinking-water is usually derived either from wells or rivers. Many of the former are provided with steps, so that the people have direct access to the water—an arrangement which is largely responsible for the dissemination of cholera when it is prevalent in the neighbourhood and for the spread of guinea worm at all times. This form of well is very much discouraged and whenever opportunity affords the steps are closed. No grant is sanctioned for their repairs without the proviso that this shall be done. These numbers have been much reduced of late years, so that now they only represent about 20 per cent. of the total wells in the country side. They are particularly objectionable when they happen to be on a route much frequented by pilgrims. In some places during fair times the villagers see that strangers and non-residents do not approach them at all. The ordinary draw-wells are almost always lined with masonry until they reach the rock. They have a parapet round the edge and a plinth with gutters to carry off the waste water. In most instances the people use their own *lotahs* and ropes; in some, however, ropes, buckets and windlasses are provided; occasionally a Persian wheel is established. Certain sums are voted annually both from the general revenues and local funds to repair and deepen them as required, they are rarely cleaned out, but when cholera appears in the neighbourhood they are treated with permanganate of potassium. It is extremely unusual to find them with any covering to protect them from dust or leaves.

In places where the people rely on rivers for their supply, the usual orders are issued warning them to reserve a selected portion up-stream from which to draw their drinking-water and guard the current above it from pollution.

It is a common practice to sink wells in the beds of *nullahs* which become dry as soon as the rains stop. They are often mere pits dug in the loose soil, with no attempt at lining or protection from waste water. In the Konkan wells are almost the universal source of supply, as nearly all the rivers run dry as soon as the monsoon ceases, the configuration of the country causing the water to be carried away at once. They are for the most part lined with a particularly porous kind of sandstone which allows of considerable percolation and as little or no attention is paid to their surroundings this must lead to more or less pollution. Latrines have been noticed unprovided with any kind of pan, and situated on the hill side only a few yards above a very large well which constituted the household supply of a group of dwellings.

In Upper Sind there are a certain number of wells fairly adequately protected as far as construction goes, but the surroundings apparently are not considered; they are often in close proximity to stables, cowsheds or manure heaps.

In the region of the delta of the Indus it is useless to sink wells as they become brackish owing to the alkaline salts in the soil. There the people have to resort to the *dhands* or pools left by the annual inundation. These often get into a most disgustingly dirty condition as the hot weather advances. I have seen the inhabitants scooping up *chattis* full of what was practically nothing else than liquid mud. No effort is made to preserve the water from contamination, buffaloes wallow and pariah dogs bathe in them, side by side with the people taking water for domestic use.

Inspectors of Sanitation and Vaccination are instructed to investigate and report on the water-supplies of the villages they pass through on tour and write suggestions in the sanitary books wherever they come across them, but very rarely any notice is taken of their remarks. The Deputy Sanitary Commissioners, whose visits are necessarily less frequent and only include a small portion of the district, call attention to the defects with much the same result. The matter really resolves itself into the question of whether the local authorities interest themselves in it. If the revenue subordinate in charge is an intelligent individual and appreciates the advantages of having good water, the people are made to carry out the advice given them otherwise, but little attention is paid to it.

Bengal.

Wells as a source of water-supply are suitable for the districts of Bankura, Burdwan, Birbhum and Midnapur, the soil in parts of these districts being laterite. In other districts of lower Bengal as well as in East Bengal tanks, *khals* and rivers are the chief sources of water-supply and the soil is often so saline that well water is brackish. Besides the people would not use a well water if that from a tank or river was available. In Bankura, Birbhum and Burdwan 9, 16 and 15 wells were sunk on an average every year during the past three years 1909-10 to 1911-12, the average cost of each well in these places being Rs. 395, Rs. 330 and Rs. 304, respectively. The average annual cost under head "provision of wells" amounted to Rs. 3,824 in Bankura, Rs. 5,277 in Birbhum and Rs. 4,658 in Burdwan. The Midnapur district authorities have not yet been able to furnish the particulars about the wells sunk in the district each year but simply report that on an average Rs. 7,030 was spent for the purpose every year during the last 3 years. A committee has recently been sitting to consider the best methods of improving the water-supply of areas for which wells are not suitable.

United Provinces.

When funds were granted by the local Government to the Sanitary Board for distribution on rural sanitation, it was decided that the money should for the first five years be spent practically entirely on the improvement of the water-supply and that the districts in which these improvements were most urgent were those in which cholera was reported year after year. Attention was principally directed to the improvement of existing wells and to sinking tube-wells in areas where the depth of sub-soil water is not above 25 feet. The amount of money allotted in 1910-11 mainly for these purposes was Rs. 90,000, in 1911-12 Rs. 48,000 and in 1912-13 was nominally Rs. 49,000 but actually on wells alone was Rs. 34,591.

In the present season the determining factors for the distribution of allotments to various districts were—

(1) if the money allotted in the previous year were fully expended,

(2) in how many districts was the cholera incidence highest ? and

(3) the protection of wells in the large grain marts situated on the railways to which country farmers flocked for the sale of their produce and in which if the wells became infected cholera would be widely spread in the surrounding districts.

Up to the present, grants have only been allotted for the improvement of tanks in the case of Gola Gokrannath, an important place of pilgrimage in which

the bathing tank is filled by sullage-polluted surface water. The water from the sacred bathing tank is imbibed as part of the customary religious ceremonies. The question of the protection of tanks will be discussed later.

In the District Board Manual the following instructions for the protection of existing wells are published:—

"The *pucca* brickwork (of the cylinder wall) should be so sloped off at the top that people drawing water from the well cannot stand upon the top or place *gharas* there. This wall may be about 14 inches thick and 2½ feet high above the platform. Two or more pulley blocks, according to requirements, should be fixed on this wall as shown on the plan and may be of either wood or iron. The object of the raised wall is to prevent the splashings from dirty or disease-infected clothes or hands and feet from going into the well. The sloping top is to keep them from putting their feet or *gharas*, which may have come in contact with vomit, etc., of a cholera patient, on the coping of the edge of the well and thus greatly increasing the danger of infecting the water of the well. Where there is an already existing *pucca* platform, the rammed *kankar* will not be required. In the event of a new platform being required it should be made of rammed *kankar*, as shown on the plan, at least eight feet broad. The platform should be well drained and the length of the *pucca* drain carrying off the water should be one-and-a-half times the depth of the well."

Districts asking for tube-wells were asked to furnish the following information:—

(1) the dry and rainy season levels of the sub-soil water below the ground surface;

(2) the character of the soil traversed by the ordinary wells of the district; and

(3) statement to the effect that the wells required are for lift irrigation to reduce ground water level, or for drinking purposes;

and if the conditions were found suitable were sent a copy of a pamphlet on tube-wells with a recommendation to use the butterfly or semi-rotary pump in place of the jug-pump, as the latter required water to be poured in from above before it would work and this operation might lead to the contamination of the well. For the sinking of these tube-wells the Chairmen of the District Boards were directed to apply to the Director of Land Records and Agriculture for the services of the trained tube-well borers employed in the district for the sinking of irrigation wells. District Boards were also sent a copy of the leaflet on the convoluted tube-well and if the Chairmen made any further enquiries in reference to this type of well, they were directed to write to the Sanitary Engineer who would give them data as to the probable life of the well with the thickness of the copper wire at present employed in its construction. The sinking of tubes in the base of present wells was also encouraged with the view of obtaining an increase in the supply of the well.

The instructions for the protection and improvement of village tanks as published in the village sanitary inspection book are as follows:—

"Where there is a stream or *jhil* near, efforts should be made to fill up all water-holes and tanks in and about the site. But in the majority of cases the village tank must remain. It is the source from which the earth of the village itself was taken, and in many cases could only be filled up by putting the materials of the huts, etc., back again. Moreover, earth for annual repairs must come from somewhere, and *zamindars* will not usually allow it to be taken from fields, etc., near the village. A tank is commonly a necessity near a village for many reasons."

It appears, therefore, that except in the few cases where streams and *jhils* exist, it will be best to endeavour to improve these village tanks and retain them in a fair sanitary condition. They should be cut to a regular shape, either square, or at all events to a right-angled figure, and the bank sloped to an angle of 45°. On one side a *ghat* some 12 feet in breadth, should be cut at an easy slope to permit ready access to the water. The floor of the tank should be levelled, and

then invariably discharges it upon the ground surface, where a pool forms. If and when the drain gets broken such pools form close to the platform and may overflow or drain into the well.

In Burma there is no efficient organization to deal with rural sanitation. Although the local Government has issued circulars from time to time urging upon district officers the importance of protecting the local water supplies from pollution, especially with reference to the prevalence and spread of cholera, and of obtaining early information of outbreaks of this disease, such outbreaks continue to be of constant occurrence, and are commonly traced to polluted water supplies. More attention is now being paid by Commissioners and district officers to the protection and up-keep of village wells and tanks than was the case some years ago, and in every district additional masonry wells and protected tanks are being provided from time to time. At the instance of this department in 1908, a number of Norton's tube-wells were brought into use at riverside towns and villages in the basin of the Irrawaddy, principally in the dry zone, and abundance of potable water of excellent quality was obtained by this means from sandbanks and the margins of the river, in the dry season, before the level of the river water rose so high as to cover its entire bed, when the tubes had to be withdrawn and stored until the following dry season. In some localities popular prejudice decided against the use of these wells, but in other places they were freely used and greatly appreciated. The pumps hitherto used have proved to be too fragile and wanting in durability for the purpose for which they are required, but these disabilities are such as can readily be overcome. There appears to be a wide field of utility for these tube-wells in Burma, especially in those localities where potable water is found within 25 feet of the ground surface throughout the year. The main difficulty in bringing them into use in such localities lies in the prevalence of saline deposits which are often met with within short distances of areas yielding sweet water. The search for potable subsoil water thus often involves a considerable outlay of time and labour, and a corresponding monetary expenditure, which has in some districts tended to bring the use of this type of well into disfavour with the officials.

A serious obstacle exists to providing complete protection from pollution to tank and well water in that no suitable apparatus has yet been devised for raising the water into the vessels of the villagers. No form of pump yet tried has proved serviceable for more than a few months. Mechanics capable of repairing metal pumps do not exist in rural areas, nor are any available on the district staffs. Any apparatus which is to be universally applicable for the end in view must in my opinion fulfil the following requirements :—

(*a*) No part of the apparatus which comes in contact with the water in the well or tank must be liable to handling by or to come in contact with the person or clothing of the water drawer. Conversely, nothing which he touches should enter the well or tank. (Thus the ordinary rope and bucket are taboo.)

(*b*) The materials of which the apparatus is constructed must all be easily replaceable or obtained locally, and where they require to be worked up on the spot they must be such materials as the Burman carpenter or wheelwright is accustomed to manipulate. A local mechanic of one of these trades will then always be available in every village to carry out the necessary repairs.

(*c*) The apparatus must be of simple construction and easily understood by village mechanics.

(*d*) The apparatus should properly have the character of an endless chain, any reversing apparatus tending to cause recurrent shocks, which speedily lead to the destruction of the apparatus.

(*e*) The labour involved in raising the water must not be more than that now experienced in drawing the water by methods to which the people are accustomed. Provision should if possible be made to admit of a child working the apparatus.

The Burmese are extremely conservative, and so far lazy as to ignore any possible benefits to health which may result from action which to them appears to involve useless labour. The issue has always been that whatever type of water-raiser has been used is found on investigation after a few months to be broken and "scrapped," while the villagers have returned to their primitive methods of drawing the water with their own private utensils.

Bihar and Orissa.

Most of the District Boards set aside a certain portion of their income each year for the improvement of water-supplies in rural areas and the local Government give an additional grant of 1/3 this sum from the sanitary budget, subject to a maximum of 3,000 in each case, and irrespective of any contributions made by the public. The local authorities also maintain registers of village water-supplies which are useful as a guide to the localities in which new supplies or improvements to the existing supplies are required.

The total average annual expenditure of the District Boards since 1895-96 is about Rs. 52,000; but it is not possible to say what proportion of this sum was spent on the construction of protected wells.

Central Provinces.

A few years ago it was the practice in these provinces for Deputy Commissioners and district councils to formulate every year a scheme for the construction and improvement of wells in rural areas and submit it for the approval of the Sanitary Board, after which the *tahsildars* and village authorities used to have the works done from district funds supplemented by subscriptions or contributions from the villagers concerned. But for the past few years no meetings of the Sanitary Board were held and no works worth mentioning were done, at least no detailed information was furnished to this office. The only information that now-a-days reaches this office is that a certain sum of money was spent by the district council, village *panchayats* and private individuals on the construction and repairs of wells.

A Sanitary Board has recently been formed and the matter will now be systematically taken up by that Board.

Assam.

With a view to improving the supply of drinking water in rural areas, the Government of Eastern Bengal and Assam passed a resolution in May 1906, laying down the conditions under which a grant for the purpose would be obtainable by local bodies. The conditions precedent to the grant of a Government contribution were that one-third of the cost of a work should be subscribed by private benevolence, and one-third by the District or Local Board. The Government would then contribute the remaining third. In July 1908 the Sanitary Board was given the discretion to relax, when necessary, the condition that the payment of the one-third of the cost should be a condition precedent to a grant. Government provide annually a certain sum for this purpose, and place it at the disposal of the Sanitary Board. The Board has ruled that applications showing (1) locality in which the work is proposed, (2) nature of work, (3) total cost of each work, (4) contributions (*a*) by the public, (*b*) Local Board, and (*c*) Sanitary Board, and (5) whether legal guarantee has been obtained, should be forwarded by the Local Board through Commissioner, on or before 31st August. The legal guarantee is to the effect that the work will be reserved for drinking purposes only, and that the public will have access to it. When grants are sanctioned, the Local Boards are asked to furnish completion certificates countersigned by the Inspector of Local Works in Public Works Department (form No. 45-B.)

The following sums were sanctioned for the last 4 years to the different Local Boards in Assam :—

	Rs.
1908-09	15,500
1909-10	17,099
1910-11	26,598
1911-12	33,752

A sum of Rs. 35,000 has been placed at the disposal of the Board for the current year. A survey of the water-supply of the Kamrup district, especially on the north bank of the Brahmaputra, where tanks and wells were considerably damaged by the earthquake of 1897, was made by Captain Gourlay, I.M.S., Deputy Sanitary Commissioner, in 1903. His report, so far as it applies to Gauhati sub-division was considered in a meeting of Commissioner, Deputy Commissioner, Vice-Chairman, and Sanitary Commissioner and it was resolved :—

(1) that the re-excavation and repairs of all existing tanks and wells should be systematically undertaken ;

(2) that experimental wells should be sunk in some of the Kachari villages, which lie between the Gohain Kamal Ali and the Bhutan Hills, to ascertain if water is obtainable ; and

(3) that a boring be sunk in the neighbourhood of Nalbari through the depth of the clay, to ascertain the existence of a water bearing stratum below it.

A scheme at an annual cost of Rs. 30,000 for five years, was drawn up, of which the Local Board was to contribute Rs. 17,500 and Government Rs. 12,500. The scheme is now passing through the fifth year of its life. A similar scheme for Barpeta sub-division was sanctioned in April 1909. The total estimated cost is Rs. 65,167 which is spread over five years. The Local Board contribute Rs. 21,722 or 4,344 annually, and Government Rs. 43,445 or 8,691 annually. A similar scheme is being worked out for the Mangaldai sub-division of the Darrang district.

In Dibrugarh a small manufactory for segments for 'ring' wells exists. The segments are rivetted together by iron keys 9" long and 1" broad and packed with cement. The composition of these rings consists of three parts stone-concrete, one part Portland cement and two parts Brahmaputra sand.

The cost for sinking such a well is Rs. 324 as per details below :—

	Rs.
Estimate of cost for a well 27 feet deep at Rs. 8 per running foot	216
Sinking	50
Setting	50
Curb	8
Rs.	324

This pattern of wells is constructed with success in the Assam Valley districts on tea-gardens, and elsewhere. In the Assam Valley, wells are constructed of masonry, or of earthen rings. They are used for drinking purposes, and the water is generally reported to be potable. In some districts of the Assam Valley, and in Sylhet and Cachar, people are prejudiced against well water, and they are not very extensively used for drinking purposes. It may be noted that from time immemorial, the water-supply of this part of the country has been derived from tanks. Under native dynasties, very large tanks were constructed by forced labour, many of which still remain. The rural water-supply, in spite of the multiplication of wells in recent years, is still very largely derived from tanks. The difficulty of protecting them efficiently against gross contamination by persons bathing and washing in them, is what renders them unsatisfactory from a sanitary point of view. On the principle that a tank which is open to pollution is probably better than any chance accumulation of surface water, which would probably be used in its absence, the Board sanctioned the grants-in-aid for constructing tanks in addition to the wells, which have been described.

AFTERNOON'S PROCEEDINGS.

RESOLUTIONS AND CONCLUSION.

His Excellency Lord Pentland, Governor of Madras, visited the Conference in the afternoon and delivered the following speech:—

"Sir Harcourt Butler and gentlemen,—It gives me great pleasure to pay this visit to your proceedings this afternoon and to take the earliest opportunity which, owing to other engagements, has been open to me of publicly associating myself with your most interesting proceedings and with the welcome which has already been given to you by Madras. By welcome I trust you will believe that I mean much more than hospitable entertainment and the necessary facilities for carrying on your labours. Those who know anything of such work know that the organization of such a gathering as yours requires not only capacity and continuous industry, but also imagination and sympathy. I trust that your President, his Committee, and all who have helped him, and all those who have initiated and taken part in your discussions, may feel that their efforts have been warmly appreciated not only by a wide circle in this presidency, but by all who are interested in the welfare of India, and that they will go away encouraged to pursue their high purpose. This is not the occasion for any review of your proceedings, and indeed it would be difficult to measure the comparative excellence and usefulness to the various parts of India of the papers which have been read and discussed. Among those which are of special interest to us here I may mention Major Greig's researches at Puri, which seem to offer valuable suggestions for further investigation by the Commission now about to be appointed. This Commission is, I understand, intended to carry out a comprehensive enquiry into the possibility of improving public health arrangements along pilgrim routes and in pilgrim centres. Then there is the subject of town-planning. Madras is, I believe, sometimes described as "a garden city." I trust that it may long remain so in spite of the progress of industry and commerce which we hope may attend us in future. Even here I fear, however, there are congested areas which might conceivably become centres of danger to those outside them, and undoubtedly tend to depress the vitality and the powers of resistance to disease, of those who live in them. We can therefore, well sympathize and co-operate with those who live under less fortunate conditions.

But I note with particular satisfaction that the range of your observations has not been confined to the towns and centres of industry. Even in a country like this, where so large a percentage of the population lives under rural conditions, there may be some danger that the clamant needs of the town and centres of industry may overshadow country interests and wants. And the importance of a pure water supply and other essential conditions of health, is as vital to the villages as it is to the large towns and cities. I trust that your presence here has given fresh energy to the subject of the health of the people. I hope that the light which your deliberations have thrown upon the various branches of this subject may be transmitted into heat and enthusiasm. There is much to be done. Lasting progress can be achieved only by the efforts of the people themselves, and the true wealth of a country, I venture to say, is to be found in the health and strength of mind as well as body of every man, woman, and child whom it contains. There is a great waste of this wealth and of human life, and there is much suffering. Even in this country, where one lives largely in the open air, the ravages of tuberculosis are becoming every year more and more apparent as light is thrown upon dark places, but now-a-days against this disease and against all diseases we work with a new hope and a new enthusiasm, for we know that most of this great waste of life can be prevented and can be prevented under the Providence of God by one thing and one thing only, namely, human effort. Ill-health, disease, vice, carelessness, ignorance these are the main causes of human suffering; gradually as the years and generations pass, they can be overcome by human effort and you may, I think, close your proceedings in the confident belief that your visit here has been of great service to a cause which we all have at heart."

The President (Sir Harcourt Butler) replied as follows:—

"On behalf of the Conference I tender to Your Excellency our most sincere thanks for the great consideration which you have shown us in coming here when

there are so many and such urgent demands on Your Lordship's time. We shall not forget the words of knowledge and encouragement which we have heard this afternoon, nor shall we forget the gracious and generous hospitality which we have received from Your Excellencies, and the interest which you have taken in our work. That work will, I believe, prove fruitful. These Conferences are valuable, not only for the conclusions reached, but for the opportunity which they afford of informing and interesting the public and of bringing together men working in isolation in different parts of India. There cannot be one sanitary programme for all India. Sanitation is rightly decentralized. We realize here as we realized at Bombay last year how different are the problems in different parts of India. But we realize also, I think, how much there is to be learned from the successes and failures in different parts of India, and from the failures no less than the successes. It is only by the patient examination of results under different conditions that we can reach the active principles of successful sanitation in the widest sense of the term. A feature of this Conferenc has been the inspection of local works organized with so much care by Mr. Hutton, Mr. Madeley, and Mr. Lacey, and the visit to the King Institute at Guindy. I hope that by extension of local inspection, the larger use of sub-committees, some selection of subjects and papers and revision of procedure, we may economize time and labour without loss of efficiency.

Our labours, though strenuous, have been lessened by the efforts of many helpers. To the Madras Government and their officers who have been unremitting in their assistance, we are greatly beholden. At every turn our work has been facilitated, whether by the post and telegraph, and telephone authorities, the Government Press, the newspapers, the South Indian Railway, or other kind friends in Madras who have lent us motor cars and in other ways have assisted us. Madras hospitality is proverbial, and we have all been made to feel that we were at home. Where all have been so helpful, it seems almost invidious to particularize, but special acknowledgment is due to Captain Justice, the Sanitary Commissioner of Madras, on whom fell the heat and the burden of the day ; to Mr. Davidson, Secretary to the Madras Government ; Dr. Gibson and his colleagues at the King Institute, Guindy ; Mr. Gilbert, Superintendent of the Government Press, and I must not forget to mention Colonel Giffard and Mr. Morton, to whom our best thanks are due. To their assistance we owe it in large measure that the Conference was the success which I believe it to have been.

It only remains for me to thank Your Excellency for crowning the kindness which we have received in this ancient and hospitable city by giving us the great honour of your presence and advice this afternoon."

RESOLUTIONS.

On the departure of His Excellency the following resolutions were considered and passed as fo lows :—

RESOLUTION AS PROPOSED.

(I) Town-Planning and Congested Areas.

(*a*) That the introduction on modern lines of town-planning schemes for the relief of congested areas in towns are among the most urgently required sanitary needs in India and that the time has come for experimental action on these lines in selected towns.

(*b*) That the term "public purpose" in the preamble of the Land Acquisition Act should be held to include the acquisition of so much land, immediately adjacent to the land required for any public improvement as it may be necessary to acquire in order to complete that improvement in the interests of the community or to make it financially possible.

(*c*) That in order to meet those cases in which it is financially impracticable to apply the Land Acquisition Act, an Act should be introduced, embodying under necessary safeguards, the English Act principle of betterment, under which owners whose lands may be improved by any improvement scheme should contribute to its cost, and also the German Act principle of redistribution by which power is given to duly constituted authority to alter the shape of and otherwise rearrange plots so as to render them more suitable for building purposes.

(*d*) That in congested areas action is desirable on the general lines of the provisions of the English Housing of the Working Classes Acts of 1890 and 1909 adapted to local conditions in India and in particular with reference to :—(*a*) Empowering local bodies to prepare and carry out improvement schemes in insanitary areas and strengthening their powers in dealing with obstructive and unhealthy houses ; (*b*) simplifying the procedure for acquisition of such areas and for assessment of compensation; and (*c*) securing the regular inspection of insanitary dwelling houses and prompt action in dealing with defects.

RESOLUTION AS ADOPTED.

(I) Town-Planning and Congested Areas.

(*a*) That the introduction on modern lines of town-planning schemes for the extension of towns and the relief of congested areas in towns are among the most urgently required sanitary needs in India and that the time has come for experimental action on these lines in selected towns.

(*b*) That the term "public purpose" in the preamble of the Land Acquisition Act should be held to include the acquisition of so much land immediately adjacent to the land required for any public improvement as it may be necessary to acquire in order to complete that improvement in the interests of the community or to make it financially possible.

(*c*) That in order to meet those cases in which it is financially impracticable to apply the Land Acquisition Act, an Act should be introduced on the general lines of the English Act and in particular embodying under necessary safeguards, the English Act principle of betterment, under which the local authority has a right to a share in the improved value which results from the carrying out of the improved scheme and also the German Act principle of redistribution by which power is given to duly constituted authority to alter the shape of and otherwise rearrange plots so as to render them more suitable for building purposes.

(*d*) That in congested areas action is desirable on the general lines of the provisions of the English Housing of the Working Classes Acts of 1890 and 1909 adapted to local conditions in India and in particular with reference to :—(*a*) empowering local bodies to prepare and carry out improvement schemes in insanitary areas and strengthening their powers in dealing with obstructive and unhealthy houses ; (*b*) simplifying the procedure for acquisition of such areas and for assessment of compensation ; and (*c*) securing the regular inspection of insanitary dwelling houses and prompt action in dealing with defects.

(*e*) That in all towns in India local bye-laws should be examined and where necessary revised with a view to the provision of sufficient air, light and ventilation in every house and room according to prescribed standards; that after a period of grace there should be an absolute veto on the occupation of rooms which fail to reach these standards; that provision should be made to prevent overcrowding and that sanitary officers should be employed with powers sufficient to see that such bye-laws are enforced.

(*f*) That in all action affecting their dwellings it is especially important to study the habits, requirements and financial means of the people, and where possible to enlist the co-operation of the leading residents in support of that action.

(*g*) That as a measure of demonstration and education efforts should be made in different parts of India to construct a model town or quarter of a town, with broad roads, sufficient air, light and ventilation at least before and behind each house, good water-supply and lighting, efficient drainage and conservancy, rat-proof and mosquito-proof houses in which overcrowding is not allowed, up-to-date markets, slaughter houses, bathing places, open spaces, recreation grounds, and an ample sanitary staff under expert supervision.

(*e*) That in all towns in India local bye-laws should be examined and where necessary revised with a view to the provision of suffiicient air, light and ventilation in every house and room according to prescribed standards suited to local conditions; that after a period of grace there should be an absolute veto on the occupation of rooms which fail to reach these standards; that provision should be made to prevent overcrowding and that sanitary officers should be employed with powers sufficient to see that such bye-laws are enforced.

(*f*) That in all action affecting their dwellings it is especially important to study the habits, requirements, and financial means of the people, and where possible to enlist the co-operation of the leading residents in support of that action

(*g*) That as a measure of demonstration and education efforts should be made in different parts of India to construct a model town or quarter of a town, with broad roads, sufficient air, light and ventilation at least before and behind each house, good water-supply and lighting, efficient drainage and conservancy, rat-proof and mosquito-proof houses, in which overcrowding is not allowed, up-to-date markets, slaughter houses, bathing places, open spaces, recreation grounds, and an ample sanitary staff under expert supervision.

RESOLUTIONS INTRODUCED AND ADOPTED WITHOUT CHANGE.

(2) TRAVELLING DISPENSARIES.

That experience in Upper India has demonstrated that under proper supervision and in suitable localities travelling dispensaries of a simple kind, apart from the question of medical relief, are measures of utility as instruments for the education of the people and as a means of reconciling them to modern methods of disease prevention.

(3) WATER-SUPPLY.

That the attention of local Governments and the Indian Research Fund Association be earnestly invited to the advisability of an exhaustive inquiry into the following matters:—(*a*) the difficulties of silt removal from river water-supplies; (*b*) the most suitable methods of water analysis and the possibility of fixing definite bacteriological standards for India; and (*c*) the plans to be adopted for conveying samples of water to and from distant laboratories.

(4) CHOLERA.

That there is strong evidence to show that in India in addition to contaminated water the four following factors are of great importance in the spread of this disease:—(*a*) convalescents discharged while still infective; (*b*) healthy persons who have been in contact with cholera cases and have acquired the infection without showing any signs of the disease but who are excreting cholera vibrios in their stools; (*c*) flies; and (*d*) the personal habits of the people.

(5) Plague.

That encouraging advance has been made in the knowledge of the etiology and epidemiology of plague and that research should be continued on the present general lines. That the results of recent enquiries point to the special importance of action in the following directions:—

(a) It is advisable to bring forcibly to the notice of the public the importance of the rat as an essential factor in the causation of plague and that plague preventive measures which aim at controlling human beings alone are insufficient and that it is more important to carry out those measures of permanent utility which tend to lessen the rat infestation of the house, such as house tidiness and improved scavenging, the prohibition of the housing of live-stock within the precincts of human dwellings and the provision of ample light and air in every room in the house. (b) Rats infected with plague are more responsible for the carriage of infection from one place to another than persons suffering from the disease. Therefore grain stores and grain markets where these animals abound play a large part in the spread of plague so that the protection of grain in grain dealers' shops, the construction of rat-proof grain godowns and where possible their erection at some distance from human habitations are useful plague preventive measures. (c) Localities infected late in one plague season are important sites of early epidemics in the next and thus potential foci of widespread infection. Special attention therefore should be directed to the definite location of such localities and the energies of plague preventive staffs, instead of being relaxed, should be concentrated on them during the quiescent period, assisting the natural forces which at this season tend to obliterate infection by well organized schemes of rat destruction, inoculation, and evacuation. General sanitation measures should also be taken to prevent as far as possible the transference of infection to other places from these infected foci.

(6) Tuberculosis.

That statistics appear to show that this disease is rapidly increasing in India especially in urban areas but that it is doubtful whether the increase is real or apparent only and due to such causes as more accurate diagnosis and registration. In view of the importance of this question a full and thorough inquiry seems desirable. That the following measures are recommended to check further spread of this disease:—

(a) The improvement of general sanitation and the opening up of congested areas, the provision of ample light and air in all inhabited rooms both in private dwelling houses and in schools. (b) The formation of anti-tuberculosis societies. (c) The establishment of tuberculin dispensaries. (d) Efficient control of milk supplies. (e) Compulsory notification of the disease at least in the larger towns.

(7) Dysentery.

That this disease is a cause of much sickness and mortality throughout India generally and that, while clinically it presents a clear and definite picture, much uncertainty and doubt still exist as to the causation of its different varieties. Seeing that on our knowledge of this depend both treatment and prevention, it appears desirable that the whole subject should be carefully and thoroughly investigated *ab initio.*

(8) Flies.

That much evidence exists incriminating the common house fly as a factor in the spread of such diseases as enteric fever, cholera, diarrhœa, dysentery and tuberculosis. Various expedients for the reduction of flies, such as incineration of rubbish and night-soil, shallow trenching, the use of perchloride of mercury or saponified cresols in latrines, have been suggested, but none of these is universally applicable. More work is required to ascertain definitely the more important breeding places of flies and how best to deal with them, but the Conference desires to impress upon local authorities the importance of thorough scavenging and of careful attention to night-soil trenches as it is clearly proved that fermenting animal and vegetable matter of all description is the favourite breeding ground of the domesticfly.

(9) Rural Water-supplies.

That impure water-supply is one of the principal causes of sickness and mortality in the rural areas of India, and is for this reason a matter deserving the most careful attention of Government. The most hopeful line of action would appear to lie in the encouragement of a more extended use of tube-wells and pumps, and further endeavour should be made to popularize this method of protecting water-supplies from pollution.

(10) Research.

That in view of the many problems of disease prevention which remain untouched in India the programme of research should be enlarged, the number of trained investigators being increased where necessary.

(11) Meetings of the Sanitary Conference.

That the meetings of the Sanitary Conference should continue to be annual.

(12) Engineering Section.

That there should be a separate secretary for the Engineering Section of the Conference and that the time for discussing questions connected with Sanitary Engineering should be extended.

(13) Number of Delegates.

That the number of delegates to Engineering Section of the next Sanitary Conference should not materially exceed the number attending the present Conference.

(14) Date of Nomination of Delegates.

That the delegates who will attend the next Conference should be nominated at least six months before the probable date of the Conference.

(15) Subjects for the Next Conference.

That the following subjects be specially considered at the next Conference, *viz.*—

(A.) Sanitary Section.

(*a*) The obtaining of vital statistics of sufficient reliability to serve as the basis of schemes of sanitary reform and judgment of their results. (*b*) Incinerators : their limitations and possibilities in different places, with reference to local climatic conditions, combustibility of rubbish, and cost. (*c*) Notification of diseases : how far it is possible to make certain diseases compulsorily notifiable and what these diseases should be. (*d*) Medical inspection of schools : suggestions as to how this might be made possible, and the agency to be employed. (*e*) Milk supply : the present defects and how these can be obviated ; standards of purity ; inspection, feeding and housing of milch cattle, registration and supervision of dairy men, and dairies. (*f*) The education of teachers and school children in hygiene : how best this can be carried out.

(B.) Engineering Section.

(1) Width of cart tyres, (2) Suitable designs for (*a*) markets, (*b*) slaughter houses, (*c*) latrines and night soil depôts, (*d*) grain godowns, (*e*) sewer connections, (*f*) cowsheds, (*g*) house connections and meters for water-supply, and (*h*) model dwellings for the poorer classes. (3) The use of cast iron, steel and ferro-concrete pipes for water-supply and drainage works. (4) Statistics of consumption of water in water-works. (5) water-supply and drainage bye-laws.

(6) The improvement of water-supply and drainage in municipalities and villages. (7) Tube-wells. (8) Statistics of pumping per pump horse power per hour.

The discussion on certain of the above resolutions was as follows.

In regard to resolution (1) clause (*a*) Mr. Turner said that many members of the Conference seemed to think that this clause applied only to congested areas, and he proposed to add the words: "for the orderly extension of towns" after "town-planning schemes". This amendment was accepted with the omission of the word "orderly" and the clause as amended was then passed *nem con.* With reference to clause (*b*) Dr. Nair asked if there was any provision for giving 15 per cent. compensation as allowed in Bombay under the Municipal Act for compulsory acquisition.

Mr. Porter pointed out that in the case of any land acquired under the Land Acquisition Act it was laid down by statute that 15 per cent. compensation would be paid. Clause (*b*) was then carried unanimously.

On clause (*c*) being introduced, Dr. Nair proposed as an amendment to omit the words "owners whose lands may be improved by an improvement scheme should contribute to its cost," and to insert the words "the local authority has a right to share in the improved value which has resulted from the carrying out of the improvement" He also said that the principle of worsement as well as of betterment should be recognised.

Rai Bahadur Ganga Prasad Varma objected to the clause on the ground that it was unsuited to the conditions prevailing in the country and because by arousing the suspicions of the people it would make the work of improvement extremely difficult. The President pointed out that in the United Provinces one of the most common cases tried in the revenue courts was a partition case in which use was freely made of the principle of redistribution. This principle applied also to the division of village sites.

Dr. Nair's amendment was then accepted with a slight change, "results" being substituted for "has resulted" and the words "on the general lines of the English Act" added after the word "introduced". Rai Bahadur Gānga Prasad Varma alone dissented.

In regard to clause (*d*) Rai Bahadur Ganga Prasad Varma proposed that sub-clause (*b*) be omitted as he thought that the present procedure for land acquisition under the Land Acquisition Act was sufficiently simple.

Dr. Nair said that Rai Bahadur Ganga Prasad Varma must have been fortunate in his experiences in Lucknow. Personally he would welcome any change to simplify the present cumbrous procedure under the Act.

Dr. Master thought that it was very desirable that the public should be sufficiently represented on any bodies that might be constituted to carry out the scheme and as regards compensation he thought that an appeal should be allowed in cases where the value of the property was above a certain limit. Longer time too should be given than one month to house owners to set their houses in order.

The clause was then carried, Rai Bahadur Ganga Prasad Varma dissenting.

On clause (*e*) being introduced Rai Bahadur Ganga Prasad Varma proposed that the following words be omitted "that after a period of grace there should be an absolute veto on the occupation of any rooms which fail to reach these standards." He thought that if the clause were to be enforced it would make thousands of people homeless and no municipal corporation was in a position to make provision for the accommodation of those whom it was proposed to expel from insanitary dwellings.

Mr. Moti Lal Ghose also objected to the absolute veto without compensation and without separate provision for lodging dishoused persons.

Captain W. C. Ross thought that the words "cubic space and floor area" should be added after the words "a standard of light and ventilation" but Mr. Williams and others thought this was unnecessary.

Dr. Master considered that bye-laws should be capable of variation to meet local circumstances. He also objected to the absolute veto.

The President suggested with reference to Dr. Master's objection that the words "suited to local conditions" should be added after "prescribed standards." Rai Bahadur Ganga Prasad Varma's amendment was then put to the vote and lost, 10 voting for and 39 against it. The clause as amended by the President was then carried by 39 votes to 3.

Clause (*f*) was carried *nem con.*

Resolutions (2) and (3) were carried unanimously.

With reference to resolution (4) Mr. Moti Lal Ghose said that to declare the personal habits of the people as an important factor in the spread of cholera was a charge against the people of too general and sweeping a character. The resolution was carried with one dissentient (Mr. Moti Lal Ghose).

On resolution (5) being introduced Captain White proposed to substitute the words "that in India plague was essentially a rat disease" for "the importance of the rat as an essential factor in the causation of plague." The amendment, however, did not meet with any support.

Dr. Nair and two others thought that in the last sentence of clause (*c*) the words from "and general sanitation" to "these infected foci" should be omitted. This amendment was also lost. Only three persons supported it. The resolution was then adopted in its original form.

Resolutions (6), (7) and (8) were unanimously adopted.

In regard to resolution (9) Mr. Moti Lal Ghose proposed that the words "reserved tanks" should be added after the words "tube-wells" since most of the water-supply in his part of the country came from the tanks and not wells.

The President stated that Mr. Ghose's remarks would be recorded. The resolution was then carried *nem con.*

The remaining resolutions were unanimously adopted, excepting resolution (11), which was carried with five dissentients, who considered that biennial conferences were sufficient.

CONCLUSION.

In reply to questions from the President it appeared that the general sense of the Conference was that the present division into sections should be maintained and the proceedings, where possible, should be further decentralised. The President assured the Conference that all questions regarding the future organisation of these meetings would be fully considered before meeting again and their wishes met so far as possible. He was prepared to agree to a proposal of the Engineering Section that they should have a separate Joint Secretary and to an extension of the time required for their deliberations. Measures would also be taken to ensure that all papers were submitted in future in ample time for full consideration by delegates.

On the question where the next conference should be held opinion was equally divided between Calcutta and Lucknow. The President stated that the decision on this point would be subsequently arrived at.

In concluding the sittings of the Conference the President said that it only remained to thank the members for the care and attention with which they had approached the important matters laid before them. He thought they had advanced matters and had laid the foundation for a much bigger advance in the future. It was well to bear in mind that India in many respects, largely owing to railway development, was on the move, and things which might seem impossible to-day would be quite possible a few years hence. They must face sanitary problems with high hopes for the future, with a full appreciation of the great difficulties involved but also with the recognition of future possibilities, and of what had been done in other countries in the world.

INDEX.

Subject.	Page.
A	
Adulteration of food and drugs	95—96
Agenda	1—4
Agra The sullage farm at——	77—78
Air— Light and——in dwellings in Bombay	11—12
Amritaraj, Dr. S— Paper by——on the medical inspection of school children	93—94
„ „ ——on the relief of congestion in the Civil and Military Station, Bangalore and its results	14—15
Analysis of water-supply of Calcutta	50
—— ——potable waters in the tropics	50—51
Annual meetings of Sanitary conference Resolution on——	110
————reappearance of plague	20—21
Artesian and sub-artesian supplies of water in Guzerat	42—43
B	
Bacteriological examination of water	51—52
Bacteriology of the cholera vibrio	63—65
Bangalore, Civil and Military Station— Relief of congestion in——	14—15
Bannerman, The Honourable Surgeon-General, W. B., C.S.I., I.M.S.,— Paper by——on Anti-malarial measures—Itinerating dispensaries ...	18—19
Bengal, Vital statistics,—	87—88
Bentley, Dr. C. A.— Paper by——on Vital Statistics, Bengal	87—88
Bombay Light and air in dwellings in——	11—12
Bose, Rai Bahadur Kailas Chandra, C.I.E.,— Paper by——on epidemic fever in Calcutta	67—68
„ „ ——on infantile mortality	67

Subject.	Page.
B—*concld.*	
Bose, Rai Bahadur Kailas Chandra, C.I.E.,—	
Paper by——on the analysis of the water-supply of Calcutta ...	50
„ „ ——on the milk supply of Calcutta	83—84
Brown, Captain H. C., I.M.S.,—	
Paper by Captain T. G. F. Paterson and——on Malta fever ...	70—71
Browning-Smith, Lieutenant-Colonel S., I.M.S.,—	
Paper by——on annual reappearance of plague	20—21
„ „ ——on a simple method of rat destruction	22
Brownlie, Mr. T. A. Miller—	
Paper by——on tube-wells	42
Building bye-laws	13
Town-planning, congested areas and——	9—15
Butler, The Honourable Sir Spencer Harcourt, K.C.S.I., C.I.E., I.C.S.,—	
Concluding remarks by——	112
Opening speech by——...	6—9
Reply by——to His Excellency the Governor of Madras's speech ...	105—106
Bye-laws, Building—	13
Town-planning, congested areas and——	9—15
C	
Calcutta	
Epidemic fever in——	67—68
Milk supply of——	83—84
Carrier	
An investigation of cholera epidemic caused by a——	60
Chandra Sekhar, Dr. P. S.,——	
Paper by——on Tuberculosis	69
Children, School—	
Medical inspection of——	93—94
Cholera	57—67
Discussion on papers relating to——	65—67
Effect of pipe water-supplies on——...	61—62

Subject.	Page.
C—*contd.*	
Cholera	
Epidemiology of——	57—58
Observations on disinfection in——	60—61
Resolution on——	108
——convalescents and contacts	
An investigation of——in India	59—60
——epidemic(s)	
An investigation of——caused by a 'carrier'	60
Measures for dealing with——	63
Practical points in dealing with——	62—63
——vibrios	65
Bacteriology of ——	63—65
Occurrence of —— in biliary passages	58—59
Clemesha, Major W. W., I.M.S.,—	
Paper by —— on mechanical filters	37—38
,, ,, —— on recent researches in the method of water analysis ...	49—50
,, ,, —— on the monsoon condition of the Hooghly river ...	35—36
Colombo drainage scheme and sewage treatment	74—75
————refuse destructor	79
Conclusion	112
Resolutions and—	105—112
Congested areas	
Resolution on ——	107—108
Town planning, —— and building bye-laws	9—15
Congestion	
Relief of ——	14—15
Conjeeveram—	
Visit to ——	80—82
Water-supply of ——	80—82
Conservancy in the tropics	67
Cossipore-Chitpore municipality—	
Mortality in the ——	87

Subject.	Page.
C—*concld.*	
Cox, Mr. C. L.—	
Paper by —— on a Colombo refuse destructor	79
" " —— on dust prevention	34
" " —— on the Colombo drainage scheme and sewage treatment	74—75
Cunningham, Captain J., I.M.S.,—	
Paper by —— and Major W. F. Harvey, I.M.S., on Dysentery ...	68
Curtis, The Honourable Mr. G. S.—	
Speech by —— on the question of the financing of water-supply and drainage schemes	44—46
D	
Delegates	
List of ——	5—6
Resolution regarding the date of nomination of—	110
" " number of Engineering——to the next Sanitary conference	110
Demonstrations in Microbiology	54
Diarrhœa in Poona	68—69
Discussion on certain resolutions	111—112
———— papers relating to Cholera	65—67
————travelling dispensaries	19—20
————Tuberculosis	70
Summary of —— on papers relating to Plague	25—26
Disinfection in cholera	60—61
Dispensaries, Itinerating	18—19
————, Travelling—	17—20
————in the United Provinces	17—18
Dracontiasis	54
Drainage	
Town improvement and —— in India	13
————scheme, Colombo	74—75
————works, Madras City—	
Inspection of ——	16—17
Dunn, Captain C. L., I.M.S.,—	
Paper by —— on measures for dealing with cholera epidemics ...	63
" " —— on the Jewell filter at Naini Tal	39—40
Dust prevention	34

Subject.	Page.
D—*concld.*	
Dwellings	
Light and air in —— in Bombay	11—12
Workmen's—	15
Dysentery	
Paper by Major W. F. Harvey and Captain J. Cunningham, I.M.S., on ——	68
Resolution on ——	109
E	
Education and Hygiene	88—94
———in Public Health	88—93
Speech by Major Liston on ——	89—92
Engineering delegates	
Resolution regarding the number of—at the next Sanitary conference ...	110
———, Sanitary—	27—35
———Section	
Proposal for a separate Joint Secretary for the ——	112
Proposal of the —— for extension of time required for their deliberations	112
Resolution regarding the appointment of a separate Secretary for the—— and the extension of the time for discussing questions connected with Sanitary Engineering	110
Resolution regarding the Number of delegates to——of the next Sanitary conference	110
———subjects for next conference	
Resolution on ——	110—111
English and Indian Sanitary Engineering	31—33
Enteric fever in India	72
Epidemic fever in Calcutta	67—68
Epidemiology of cholera	57—58
Exhibition of models of a house suitable for villages and small towns, a typical section of an infilteration gallery, wells, house connections and fly-proof latrines	35
F	
Fever, Enteric — in India	72
———, Malta—	70—71
Fevers and infectious diseases	68—72
Filter, Jewell — at Naini Tal	39—40
Filters, Experimental Sand and Mechanical—	
—— at the King Institute, Guindy	54—55
——— Mechanical—	37—39
——— Percolating—	74
Financing of water-supply and drainage schemes	44—49
Firth, Colonel R. H., R. A. M. C.,—	
Speech by —— on the bacteriological examination of water ...	52—53
Fleas	
Note on —— infesting Mus Rattus	24
Flies	
Resolution on ——	109

Subject.	Page.
F—*concld.*	
Fly breeding	
Night soil disposal and associated ——	75
——Proof latrines	
Exhibition of models of —— by Major Forbes-Knapton, I.M.S., and Mr. Pillai	35
Food and drugs	
Adulteration of ——	95—96
Forbes-Knapton, Major H. A., I.M.S.,—	
Exhibition of a model of a fly-proof latrine by ——	35
Paper by —— on some practical points in dealing with cholera epidemics	62—63
Fox, Lieutenant C. J., I.S.M D.,—	
Paper by —— on Tuberculosis	70
——Military Assistant Surgeon E. C. R., I.S.M.D.,—	
Papers by —— on bacteriological examination of water	51—52
Future Sanitary conferences	
Division into sections to be maintained at ——	112
G	
Ganga Prasad Varma, The Honourable Rai Bahadur—	
Note by —— on town-planning and town improvement in Lucknow ...	13
Gibson, Dr. F. Maitland—	
Paper by —— on water analysis in the tropics	50—51
Gloster, Captain T. H., I.M.S.,—	
Paper by —— on cholera vibrios	65
Governor of Madras, His Excellency the——	
Speech by ——	105
Grain trade as a factor in the dissemination of plague	22—23
Greig, Major E. D. W., I.M.S.,—	
Paper by —— on an investigation of cholera convalescents and contacts in India.	59—60
" " —— on an investigation of cholera epedemic caused by a 'carrier.'	60
" " —— on enteric fever in India	72
" " —— on observations on disinfection in cholera ...	60—61
" " —— on the occurrence of cholera vibrio in the biliary passages	58—59
Guindy	
Visit to ——	53—56
H	
Harriss, Major S. A., I.M.S.—	
Note by —— on building bye-laws	13
Paper by —— on the effect of pipe water-supplies on cholera ...	61—62
" " —— on the milk supply of towns	84—85
" " —— on the sullage farm at Agra	77—78

Subject.	Page.
H—*contd.*	
Harvey, Major W. F., I.M.S.,—	
Paper by —— and Captain J. Cunningham, I.M.S., on dysentery ...	68
" " —— on vaccine lymph	53—54
Hooghly river	
Monsoon condition of the ——	35—36
Housing of working classes in large cities	15
Hutchinson, Major F. H. C., I.M.S.,—	
Paper by —— on percolating filters	74
" " —— on the Poona experimental sewage installation ...	73—74
Hutton, Mr. W.—	
Explanatory address by —— on experimental sand and mechanical filters at the King Institute, Guindy.	54—55
Paper by —— on infiltration galleries	41
" " —— on sanitary problems in Madras	27—31
Particulars furnished by ——about Conjeeveram water-works ...	80—82
Hydro-electric scheme, Simla...	27
Hygienic rules, Simple—	
—— for the guidance of municipalities in laying out sites and planning model houses for poorer classes.	15
Hygiene	
Education and ——	88—94
Miscellaneous papers on ——	67—68
Popular errors in ——	67
I	
Incinerators	
Disposal of rubbish in Madras city by means of small ——	75—77
Indian Sanitary Engineering, English and ——	31—33
Infantile mortality	67
Infection	
The importance of the persistence of —— in certain villages during the off plague season.	21
Infectious diseases, Fevers and ——	68—72
Infiltration galleries	40—41
Inoculation	
Absence of 'Negative phase' after——with plague prophylactic ...	24
Inspection of food and drugs	95—96
————Madras city drainage works	16—17
————Madras city water-works	57
————models of a house suitable for villages and small towns, a typical section of an infiltration gallery, wells, house connections and fly-proof latrines	35

Subject.	Page.
I—*contd.*	
Itinerating dispensaries	18—19
Iyengar, Mr. Rangasawmy—	
Paper by —— on mechanical filters	38—39
J	
Jewell filter at Naini Tal	39—40
Joint Secretary	
Proposal for a separate —— for the Engineering Section	112
K	
Kunhardt, Captain J. C. G., I.M.S.—	
Paper by —— on the importance of the persistence of infection in certain villages during the off-plague season.	21
L	
Lacey, Mr. J. M.—	
Exhibition of models of sanitary works by ——	35
Paper by —— on infilteration galleries	40—41
Lands, low-lying—	
Reclamation of —— with refuse	78—79
Large cities—	
Housing of working classes in ——	15
Light and air in dwellings in Bombay	11—12
List of delegates	5—6
Liston, Major W. G., I.M.S.,—	
Paper by——on plague preventive measures	24—25
Speech by——on education in public health	89—92
Lucknow	
Sullage treatment at——	78
Town improvement in——	13

Subject.	Page.
M	
MacDonald, Dr. W. R.—	
Paper by——on the disposal of rubbish in the Madras city by means of small incinerators.	75—77
Mackey, Military Assistant Surgeon G., I.S.M.D.,—	
Paper by——on the utilisation of a continuous temperature of 50°C. for the preservation of the potability of milk.	83
Mackie, Captain F. P., I.M.S.,—	
Paper by——on sleeping sickness	55—56
Madeley, Mr. J. W.—	
Paper by——on the Madras city drainage works	16—17
„ „ ——on the Madras city water-works	57
Madras	
Sanitary problems in——	27—31
——city	
Disposal of rubbish in——	75—77
————drainage works—	
Inspection of——	16—17
———— water-works—	
Inspection of the——	57
————presidency—	
Plague in——	23—24
Malta fever	70—71
Mandy, Mr. C. N.—	
Note by——on sanitation in India	33—34
Master, Dr. D. B.—	
Paper by——on the reclamation of low-lying lands with refuse ...	78—79
Measures for dealing with cholera epidemics	63
————, Plague preventive—	
Paper by Major Liston on——	24—25
Mechanical filters	37—39
————————, Sand and————	
at King Institute, Guindy	54—55

Subject.	Page.
M—*contd.*	
Medical inspection of school children	93—94
Meetings of Sanitary conference	
Resolution on——	110
Mehdi Shah, The Honourable Khan Bahadur Syed—	
Paper by——on the sanitation of villages and small towns ...	94
Microbiology	
Demonstrations in——	54
Milk	
The utilisation of a continuous temperature of 50° C. for the preservation of the potability of——	83
——problem, Indian—	
Practical points in the——	85—87
——supply	
——of Calcutta	83—84
——of towns	84—85
Problems connected with——	83—87
Model(s) houses	
Simple hygienic rules for guidance of municipalities in laying out sites and planning——for poorer classes	15
——of a house suitable for villages and small towns, a typical section of an infiltration gallery, wells, house connections and fly-proof latrines	35
——of sanitary works, Exhibition of——	
Monsoon condition of the Hooghly river	35—36
Montgomery, Mr. A. S.—	
Paper by—on Simla hydro-electric scheme	27
Morison, Captain J., I.M.S.,—	
Paper by——on the causes of diarrhœa in Poona	68—69
Mortality—in the Cossipore-Chitpore Municipality	87
Mus Rattus—	
Note on fleas infesting——	24
N.	
Naini Tal	
Jewell filter at——	39—40
Nair, Dr. T. M.—	
Paper by—on the inspection of food and drugs	95—96
Negative phase	
Absence of—after inoculation with plague prophylactic	24

Subject.	Page.
N—*contd.*	
Newell, Dr. A.G.—	
Paper by—on conservancy in the tropics	67
„ „ —on some practical points in the Indian milk problem ..	85—87
Next Sanitary conference	
Resolutions regarding the number of Engineering delegates at——and the date of their nomination	110
Night soil disposal and associated fly breeding	75
Note on Sanitation in India	33—34
Nowroji, Mr. Hormusji—	
Paper by—on the water-supply of Conjeeveram	82
O	
Opening speech of the President	6—9
Orr, The Honourable Mr. J. P., I.C.S.,—	
Paper by —— on light and air in dwellings in Bombay	11—12
P	
Paterson, Captain T. G. F., I.M.S.—	
Paper by —— and Captain H. C. Brown, I.M.S., on Malta fever ...	70—71
Patton, Captain W. S., I.M.S.—	
Demonstrations by —— in Microbiology	54
Pentland, His Excellency Lord—	
Speech by ——	105
Percolating filters	74
Pillai, Mr. V. D.—	
Exhibition of a model of a fly-proof latrine by ——	35
Paper by —— on town improvement and drainage in India ...	13
Pipe water-supplies	
Effect of ——on cholera	61—62
Plague	20—26
——preventive measures	24—25
Annual reappearance of ——	20—21
Grain trade as a factor in the dissemination of ——	22—23
—— in Madras Presidency	23—24
Prevention of ——	24
Resolution on—	109

Subjects.	Page.
P—*contd.*	
Plague deaths Defective registration of——	21—22
——infection The importance of the persistence of——in certain villages during the off-plague season	21
——Prophylactic Absence of a 'Negative' phase after inoculation with—	24
Poona experimental sewage installation	73—74
Poorer classes Simple hygienic rules for guidance of municipalities in laying out sites and planning model houses for ——	15
Popular erros in hygiene	67
Potable waters Analysis of —— in the tropics	50—51
Practical points in the Indian milk problem	85—87
President, concluding remarks by——	112
——'s opening speech	6—9
—— reply to His Excellency the Governor of Madras's speech ...	105—106
Preventive measures, Plague—	24—25
Prevention of Plague	24
Prophylactic, Plague— Absence of 'Negative phase' after inoculation with——	24
Public health Education in ——	88—93
Speech by Major Liston on education in——	89—92
Tuberculosis and its relation to——	69
Punch-Chabal system of water filtration	41—42
R	
Rat destruction A simple method of ——	22
Reclamation of low-lying lands with refuse	78—79
Refuse destructor, Colombo.	79
—— disposal, Sewage and ——	73—79
Registration, Defective— ——of plague deaths	21—22
Relief of congestion	14—15
Reply by the President to His Excellency the Governor of Madras's speech ...	105—106
Research Resolution on——	110

Subject.	Page.
R—*contd.*	
Resolutions	107—112
——— ——and conclu sion	105—112
Resolutions	
Discussion on certain ——	110—112
Richards, Mr. E. P.—	
Paper by —— on the prevention of dust in Indian city roads and streets	34
River water-supplies	
Removal of silt for purification of ——	36—37
Ross, Captain H., I.M.S.,—	
Note by —— on fleas infesting Mus Rattus	24
Paper by —— on travelling dispensaries in the United Provinces ...	17—18
—— Captain W. C., I.M.S.,—	
Paper by —— on popular errors in hygiene	67
" " ——on prevention of plague	24
" " ——on the epidemiology of cholera	57—58
Rubbish	
Disposal of——in Madras	75—77
Rules, Simple hygienic, ——	
——for laying out sites and planning model houses for the poorer classes	15
——Sanitation	94—95
———— in Bengal	94—95
—— water-supplies	96—104
———— in Assam	103—104
———— Bengal	98
———— Bihar and Orissa...	103
———— Bombay	97—98
———— Burma	100—103
———— Central Provinces	103
———— Madras	96—97
———— Punjab	100
———— United Provinces	98—100
Resolution on——	110

Subject.	Page.
S	
Sand and mechanical filters at King Institute, Guindy	54—55
Sanitary conferences, Future—	
Present division into sections to be maintained at	112
——— next—	
Resolutions regarding the number of Engineering delegates at——and the date of their nomination	110
———Engineering	27—35
Resolution regarding the extension of the time for discussing questions connected with——	110
———, English and Indian—	31—33
———problems in Madras	27—31
———subjects for next conference	
Resolution on——	110
———works	
Exhibition of models of——	35
Sanitation in India, Note on——	33—34
——— of villages and small towns	94
———, Rural—	94—95
School children	
Medical inspection of——	93—94
Secretary	
Resolution on the question of the appointment of a separate—for the Engineering section of the conference	110
Sections	
Present division into——to be maintained at future Sanitary conferences	112
Sewage and refuse disposal	73—79
———installation, Poona experimental ——	73—74
———treatment	
Colombo drainage scheme and ——	74—75
Silt	
Removal of —— for purification of river water-supplies	36—37
Simla hydro-electric scheme	27
Sleeping sickness	55—56

Subject.	Page.
S—*contd.*	
Speech	
—— by Colonel Firth on the bacteriogical examination of water ...	52—53
—— by His Excellency the Governor of Madras	105
—— by Major W. G. Liston, I.M.S., on education in public health ...	89—92
—— by the Honourable Mr. Curtis on the question of the financing of water-supply and drainage schemes.	44—46
—— by the President in reply to His Excellency the Governor of Madras's speech.	105—106
President's opening ——	6—9
Standley, Mr. H.W.—	
Paper by —— on the sullage treatment at Lucknow	78
Stevenson, Captain W.D.H., I.M.S.,—	
Paper by —— on the absence of a 'Negative phase' after inoculation with plague prophylactic.	24
Stokes, Major T.G.N., I.M.S.,—	
Paper by —— on education in Public health	88—89
Subjects for next Sanitary conference	
Resolution on ——	110
Sullage farm at Agra	77—78
—— treatment at Lucknow	78
T	
Taylor, Captain J., I.M.S.,—	
Paper by — on plague in the Madras presidency	23—24
Temperature	
The utilisation of a continuous —— of 50° C. for the preservation of the potability of milk.	83
Time	
Resolution regarding the extension of —— for discussing questions connected wtth Sanitary Engineering.	110
Town improvement and drainage in India	13
——————in Lucknow	13
——planning	
—— congested areas and building bye-laws	9—15
Paper on —— by Mr. E. G. Turner	9—10
Resolution on ——	107—108

Subject.	Page.
Towns	
Milk supply of ——	84—85
Travelling dispensaries	17—20
——————— in the United Provinces	17—18
Resolution on ——	108
Tropics	
Conservancy in the ——	67
Tuberculosis	69—70
Discussion on——	70
Resolution on ——	109
The prevention of —— in Madras	69
———————and its relation to Public Health	70
Tube-wells	42
Turkhud, Dr. D. A.—	
Paper by —— on defective registration of plague deaths	21—22
„ „—— on Dracontiasis	54
Turner, Dr. J. A.—	
Paper by —— on housing of working classes in large cities in India ...	15
„ „ —— on the bacteriology of the cholera vibrio	63—65
Turner, Mr. E. G., I. C. S.,—	
Paper by —— on town-planning	9—10
U	
United Provinces	
Travelling dispensaries in the ——	17—18
Urban water-supplies	35—43
V	
Vaccine lymph	53—54
Villages and small towns	
Sanitation of ——	94
Visit to Conjeeveram	80—82
—— Guindy	53—56
Vital statistics	87—88

Subject.	Page.
V—contd.	
Vital Statistics, Bengal	87—88
W	
Water	
Artesian and sub-artesian supplies of——in Guzerat	42—43
Bacteriological examination of——	51—52
——Analysis	49—53
Recent researches in the method of——	49—50
——Supplies, River—	
Removal of Silt for purification of——	36—37
——Rural :—	96—104
—— in Assam	103—104
—— Bengal	98
—— Bihar and Orissa	103
—— Bombay	97—98
—— Burma	100—103
—— Central Provinces	103
—— Madras	96—97
—— Punjab	100
—— United Provinces	98—100
Resolution on——	110
——supply	
Analysis of ——of Calcutta	50
——of Conjeeveram	80—82
Resolution on——	108
—— and drainage schemes	
Financing of——	44—49
——works, Madras City—	
Inspection of the——	57
West, Mr. C. H.—	
Paper by——on the Puech-Chabal system of water filtration ...	41—42
" " ——on the removal of silt for purification of river water-supplies	36—37
White, Captain F. Norman, I.M.S.—	
Paper by——on grain trade as a factor in the dissemination of plague ...	22—23
Williams, Mr. G. B.—	
Paper by——on English and Indian Sanitary Engineering ...	31—33
Wood, Mr. W. G.—	
Paper by——on simple hygienic rules for the guidance of municipalities in laying out sites and planning model houses for poorer classes.	15
Working classes	
Housing of——in large cities	15
Workmen's dwellings	15

45 D S—25 6 15—GCBP Simla